THE

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THE

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DIRECT COUPLED PLANTS.

ONE hears so much at the present time of American standards, that it comes almost as a shock to read an address by an American engineer before an American engineering society, the text of which is practically based on the want of standards in American electrical work. Yet Mr. J. B. Stanwood, before a recent meeting of the American Society of Mechanical Engineers, urges the members very strongly to adopt standards for direct coupled generating sets. On the question of standards, we, in this country, thought we had everything to learn from the States, and it comes almost as a positive relief to find that in one direction at least the Americans are probably not in as good a position as we ourselves. It is readily admitted, as the author of the paper points out, that the application of standards has proved an important feature in the industrial progress of America, for the Americans have standard dimensions for materials, standard sizes for the parts and capacities of machines, standard gauges for measurements, and standard systems of inspection. There is very little doubt that the care with which such systems have been elaborated, has permitted an interchangeability which is comparatively rare on this side of the Atlantic. Having regard to these things, therefore it is a little curious that on one particular branch of electrical work it should be necessary to call the attention of Americans to their short-comings. Direct driving, Mr. Stanwood points out, has been responsible for great alterations in the design of machines, and this has involved manufacturers in great expense. Curiously enough the author refers to a system in America which we have always supposed was monopolised by this country, that is, the specifying, by a third party, usually a consulting engineer, of a type of engine which was not in stock, or differed in detail from standard types. Apparently, however, such conditions are not confined entirely to Great Britian, for not only is trouble referred to under this head, but the difficulties of obtaining complete co-operation between a dynamo-builder and an engine-builder are dwelt upon. But it is new to us to find trouble arising under such circumstances, and one can hardly realise Mr. Stanwood's complaint that the dynamo-builder may have to wait for the engine-builder, after which there comes the adjustment of the engine's speed to suit the generator's speed. In direct coupled plants the electrical engineers of this country have had special experience, and, indeed, it is not going too far to say that, England being practically the home of direct driving plants, much of the trouble that is being experienced in America in fitting engines and dynamos hardly ever arises here. Apparently in the States the question is felt so acutely that a plea was put forward for a standard series of capacities and speeds. Moreover, it is said that those parts of the engine and generator which have to be connected or fastened together should be standardised for each different size, to facilitate the assembling of a combined machine or set. Apparently the author of this paper assumes that such a

system introduced by Americans both at home and abroad might give them a large share of the electrical and engineering business of the world. In order to achieve this, Mr. Stanwood makes some recommendations as to standardising the dimensions of those parts of the engine and dynamo which are connected together, they are:—(*a*) the shaft diameter and armature bearing, which should be expressed in thousandths of an inch; (*b*) the length of shaft outside the engine and the location thereon of the bearing should be given in inches and feet; (*c*) the distance from the centre of armature to sub-base in inches, and (*d*) the length and width of generator base, and the size and location of the bolts which attach it to the sub-base. Apparently these are the chief requirements which are to enable the Americans to take possession of the world's markets as far as direct coupled plants are concerned. We have the greatest admiration for American practice in certain directions, and we should hardly have thought that such trouble had been experienced in arranging dynamos and engines for direct driving. English designers of dynamos, first and foremost, have designed their machines for direct driving, and we can hardly conceive that any of our large engine-builders experienced trouble in the directions indicated by Mr. Stanwood. Even in the driving of alternators it has been for some time past the standard practice in this country to make the alternator as an integral part of the engine, and we do not think that any modern station is ever designed for rope or belt driving. In some respects the Americans have themselves demonstrated the efficacy of direct coupled plant, but their practice has differed from ours in that they have employed slow speed Corliss engines provided with considerable fly-wheel energy. On the contrary, standard practice in this country has been to directly connect high speed engines, and it can hardly be said that the method has not proved a distinct success. There is, of course, a considerable tendency in some quarters to adopt a slow speed engine of the American type, particularly for tramway work, and it will be interesting to watch the effect of this type of plant in the development of electricity supply. There are many engineers who hold the opinion that in spite of the success of the high speed engine, we shall be compelled eventually to adopt an engine having a low piston speed. Whatever may be the true aspect of the case, it can hardly be said that the adoption of American engines is part of that reversal of policy; indeed, it would appear to be due rather to the manner in which the Americans have been able to place their tramway apparatus upon the English market. This much may be said, beyond all question there does not appear to be any decided limitation to the size of high speed engines. Years ago, when the Willans engine first came to the rescue of electricity supply, one scarcely expected that there would have been such an extraordinary development in this class of prime mover. And so completely is the practice of engine-builders altered in regard to size, that they practically refuse to build a high speed motor of less than 60 H.P. It is not long ago that we recorded in these columns the fact that Willans & Robinson were making an engine of 5,000 H.P.; that alone ought to be a partial answer to the out-and-out advocates of slow speed engines. It is said occasionally that a high speed engine is all very well as long as nothing goes wrong, but it is difficult to see wherein it differs from other engines. Not long ago it became a well-known axiom in American electricity works employing slow speed engines to retreat behind a pillar and await developments whenever the engine reached a certain speed. That the precaution was not wholly unnecessary was shown by the occasional bursting of heavy fly-wheels.

The Pulverization of Metal Cathodes.—Last year it was found by Fritz Haber that the electrolysis of hydrochloric acid with platinum or platiniridium electrodes resulted in an attack of the platinum at ordinary temperature when the acid is concentrated, but the platinum remained unaffected when the concentration is below 30 per cent. HCl. Platiniridium containing 10 per cent. of iridium was hardly attacked at all by the concentrated acid, and if the alloy contained 20 per cent. of iridium it remained unaffected. At the boiling point an 11 per cent. acid solution attacks the platinum as vigorously as a 36 per cent. solution at the ordinary temperature, but an 8 per cent. solution leaves the platinum intact. During the course of the electrolysis a deposition of platinum on the cathode is observed, but this is not due to transference of platinum from the anode to the cathode, as the cathode loses in weight. It is probably due to mechanical action, and in some way connected with the absorption of gases by the platinum. Lead is found to behave in a similar manner, so that formation of a layer of spongy lead on the cathode can be obtained by the electrolysis of sulphuric acid with lead electrodes. Since this Haber has associated himself with Georg Bredig, and has continued his researches, an account of which is given in the *Berichte der Deutschen Gesellschaft*, Vol. 31, pp. 2741—2752. When a cathode consisting of a bright lead plate or wire conveying a current at 24—72 volts is brought into dilute sulphuric acid, a platinum anode being employed, a momentary pulverization of the lead occurs, and a fine metallic powder falls through the liquid. This takes place at isolated spots on the surface of the metal, bright indentations being left, with rounded edges. A similar phenomenon takes place in alkaline solutions, but in this case it is continuous and much more energetic. The metallic lead thrown down is peculiarly susceptible to chemical change, and can readily be converted into white lead by the simultaneous action of air and carbonic anhydride. The addition of small quantities of a chromate of chromium salt prevents the occurrence of the phenomenon. Mercury, tin, bismuth, thallium, arsenic, antimony, and Rose's metal all show the same phenomenon in alkaline solutions, whereas cadmium, zinc, copper, silver, aluminium, platinum, and palladium do not act in this way. In acid solution, on the other hand, only bismuth and Rose's metal behave in a similar manner to lead. The phenomenon is to be distinguished from the loosening of the surface which occurs with cathodes of platinum, palladium, and lead. In an alkaline solution, it is probably preceded by the formation of an alloy of the metal of the cathode with the alkali metal present, which is then decomposed by the water. This is especially marked in the case of mercury, but no similar action can occur in acid solution.

Single Differences of Potential.—Hector R. Carveth has determined a number of single differences of potential by the dropping mercury method, attention being directed more especially to the measurement of metals in solutions of their salts; in opp ition to the results of Paschen, it would appear that both anion and cation have an effect. With different concentrations of the same electrolyte the values obtained apparently follow in regular order. Cases in which the dropping electrode gives values corresponding with the polarization method have been observed, as well as cases in which a difference in the value occurs. The solution pressure formula of Nernst was tested and found to hold approximately in a few cases, whilst in the great majority of cases it failed. The author concludes that the values given by the drop electrodes are not true single differences of potential. The above is an abstract of a paper in the *J. Physical Chem.*, Vol. 2, pp. 289—321.

MACHINE TOOLS.*

(*Concluded from page* 164.)

Fig. 17 illustrates a good example of a powerful profile and general milling machine with a rising and falling cross-slide by W. Muir & Co., Limited. The general design approaches that of an ordinary planer. The table is driven by a screw, and is provided with self-acting, longitudinal reversing and hand-feed motions, also quick traverse in either

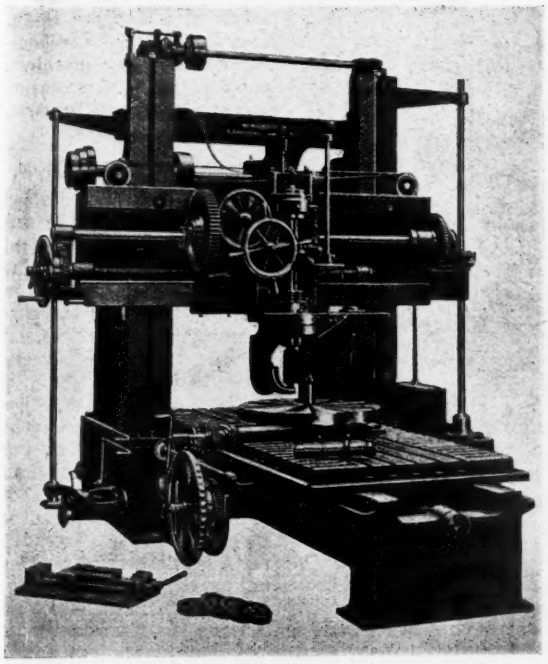

Fig. 17.

direction by power. A useful attachment is a removable self-acting circular table. The saddle on the cross-slide is fitted with variable and reversing self-acting and hand feeds; there is also a quick traverse and balance weight when doing "former" work. This machine, which is treble-geared, has a spindle 4 inches diameter, and will admit 4 feet 7 inches between uprights. It weighs 14 tons, and is a very fine English-built tool.

Planing Machines.

The importance of the planing machine is only equalled by that of the lathe. Experiments with an electrically-driven planer have revealed the fact that the return stroke absorbs twice the power taken by the cutting stroke. Joseph Buckton & Co., Limited, have designed a planer with a double cutting tool box, and have also fitted the machine with a quick return for use where cutting in both directions is not applicable. Mr. Bird's tool holder shown in fig. 18 effects the same purpose and cs be applied to existing machines. The inventor has also designed a special feed mechanism, to ensure an independent but alternative feed to either tool.

A powerful Armstrong-Whitworth screw-driven planing machine, capable of planing up to 12 feet wide by 12 feet high, is shown by fig. 19.

Fig. 20 shows a high class make of American planer; the general design approaches the English style, the chief difference being in points of detail, methods of feed, and driving motions. The spiral system is more in vogue in America than here, although this particular machine is rack-driven.

Side planers are now so much in use, that reference is hardly necessary; it will be recollected that the machine is a combination of a planer and shaper, the advantage over the former being the saving in space, and over the latter the length of stroke.

Space does not permit of reference to other types of planers, such as wall planers, plate edge planers, &c.

Shaping Machines.

These machines, which are largely being replaced by milling machines, we have not thought it necessary to illustrate in this article.

Slotting Machines.

There is nothing sufficiently novel to justify any special reference.

Keyway Cutting Machines.

Fig. 21 illustrates an American keyway cutting machine, the special features of interest being the upper support for the cutter bar. The keyways are always cut central; the depth of the cut is regulated by a micrometer screw, which facilitates repetition work; the cutting tool has perfect clearance on the upward stroke.

Punching and Shearing Machines.

There are no striking developments in this direction.

Bending and Straightening Machines.

The size of these machines is assuming large proportions, as may be inferred from a machine by Craig & Donald for bending mild steel plates 1½ inches thick to 12 feet wide. The machine weighs 75 tons.

Metal-Sawing Machines.

Considerable attention is being devoted to this class of machine, and makers recognising how greatly success depends upon the proper condition of the saw blade, are fitting a self-contained grinding attachment to the machines.

Forging and Welding Machines.

The "Standard" hand-power forging and welding machine made by the Jos. C. Nicholson Tool Company is an excellent tool, that ought to find a place in every smithy. It is of

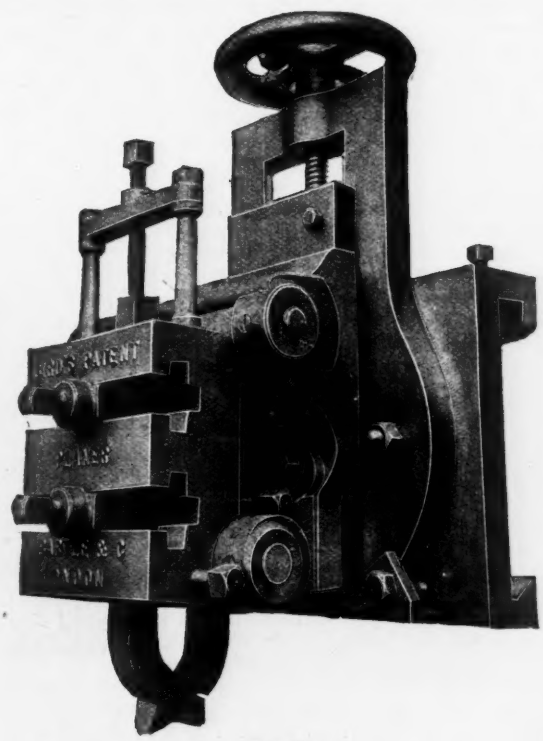

Fig. 18.

very simple character, and consists of a pair of clamps for holding the two pieces of iron to be welded, and a powerful lever arrangement for forcing them into contact when at welding heat. With this tool no scarf is required, and the weld is actually stronger than the original bar. By

* Editorial abstract of a paper on "Machine Tools," by E. C. Amos, recently read before the Society of Engineers.

reversing the lever arrangement the machine can be used for drawing out and elongating bars.

Hydraulic Machine Tools.

Space does not permit of an extended description of water-driven tools, the advantages of which are now well known.

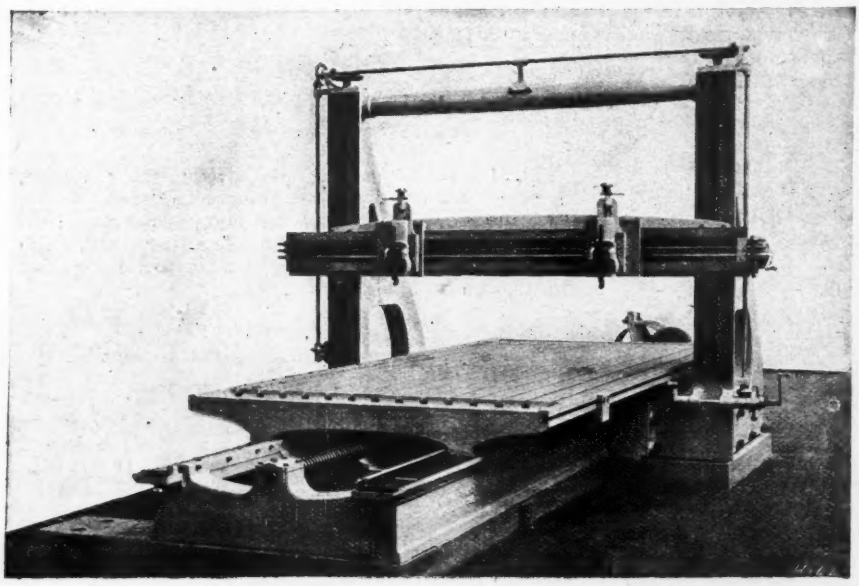

Fig. 19.

One of the more important developments in the direction of boiler makers' tools (to which class of tool hydraulics are particularly suitable) is a boiler shell plate bender, by Fielding and Platt, Limited. It is quicker in its action than rolls, and costs less, does not occupy so much space, and bends narrow strips as accurately as shell plates.

The plate to be bent passes through a vertical slot in the press, the two edges of which are respectively convex and concave. These edges are made to approach each other by means of a vertical ram operating upon an inclined plane. The method of working is very simple; the plate being placed edge up on small rollers on a cast-iron floor, is pulled through the machine in steps of 3 inches by means of an automatic feed gear, after every stroke of the bending girder.

Another useful type of machine is a hydraulic flue flanger, which will flange an Adamson flue ring at one heat, and will also do many other kinds of work in stamping, welding, and bending.

The chief advantages obtaining from the use of hydraulically-driven tools are the simplicity of mechanism and saving in power from gearing and belting losses, another advantage being the independence of line shafting, it being possible and easy to put tools down in any position.

Space does not permit of description of other classes of hydraulic tools, such as punching, closing and riveting machines, and for forging, welding, shell drawing, tube drawing, wheel bossing, &c.

Pneumatic Tools.

The rapidly increasing use of pneumatic tools demands some reference to them.

One of the most commonly used pneumatic tools is the hand hammer, which is used for chipping, caulking, driving hot rivets, heading, driving nails and spikes, scaling boilers, &c. The hammer contains a rapidly reciprocating piston, which carries the operating tool. The shock or vibration is very much less than might be expected.

The pneumatic breast drill is another example of the air-driven tools.

Another type of tool is the riveter, to which compressed air lends itself even better than steam or hydraulic pressure, and the speed at which good work can be effected pays for the cost of these machines very quickly.

Other Tools.

Space does not allow of more than a reference to the following tools :—Wheel-cutting and dividing machines, emery grinders, measuring machines, gauges, gas furnaces, chucks and hand tools.

British v. American Tools.

The author has devoted considerable attention to this subject, and has been forced to the conclusion that the majority of tool makers in this country are not keeping pace with those in America, and that the large sale of American tools in this country is good evidence of their quality.

The author, who, it may be mentioned, is not interested or connected with any American firm of tool makers, is of opinion that it lies within the power of the majority of British makers to turn out tools comparable with those of their trans-Atlantic cousins, but this can only be done by wholesale scrapping of obsolete designs, and by adopting more modern methods of manufacture. The advent of the foreign tool is certainly a blessing in its

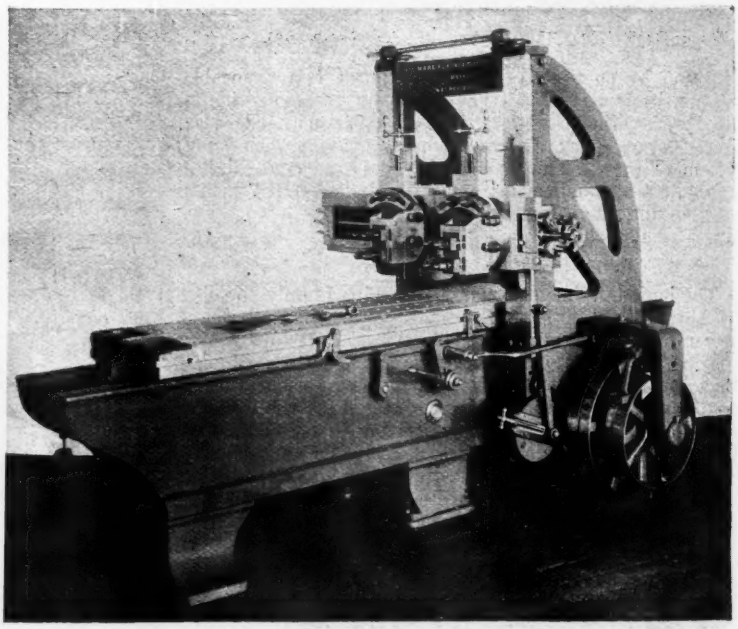

Fig. 20.

dual capacity of improving the efficiency and output of the users' works, and of furnishing data for the improvement of their own tools.

It is only fair to remember that many of the ideas embodied in American machines originated in this country; but the Americans, by their marvellous attention to detail, have so improved the original designs, as to make them hardly recognisable.

The difference between the two makes is more one of design than quality of workmanship. Tool makers are more or less guided by the requirements of their customers, but the Americans, with their high wage rate, have been stimulated to make a special study of reducing labour to a minimum, and have, as a consequence, produced a highly productive class of tool. The English are now following suit, and have, in some cases, "gone one better," but, generally speaking, the progress is slow. Owing to the abnormal boom in trade, they have not experienced the necessity of greatly improving their tools, but the slump is bound to come, and they should be preparing for it.

That Americans can compete in the English market is greatly due to the fact of their specialisation of one or two classes of tool, in which, as a consequence, they excel.

The English have also a lesson to learn in the matter of selling their productions, most of them being chary of imitating the American practice of opening showrooms in large towns.

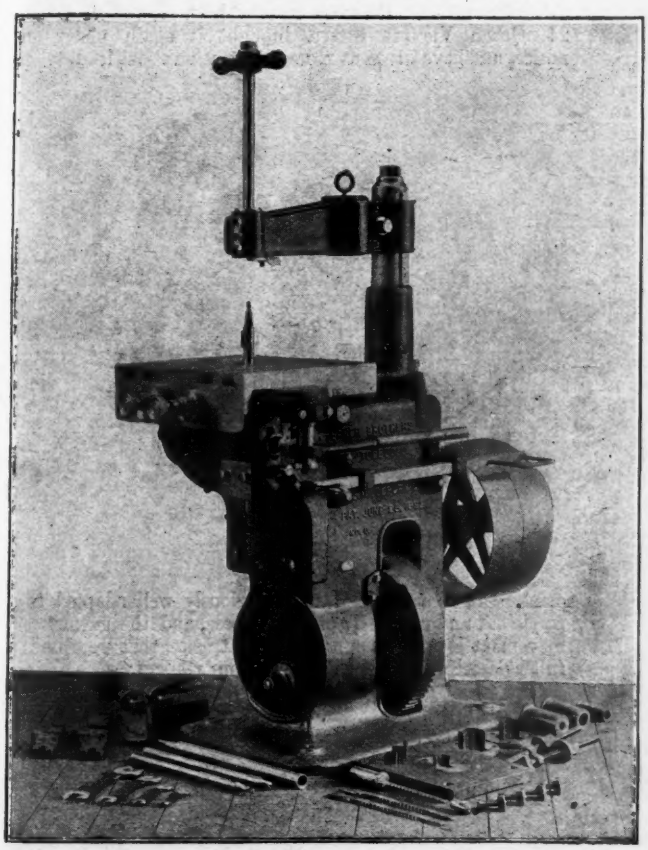

Fig. 21.

Of the lighter class of tools, including hand-tools, the American make is undoubtedly superior to our own.

Then, again, where Americans gain so much is in their methods of manufacture, for they put in hand at least a dozen tools, which permits the employment of elaborate jigs and templates, whilst we, as a rule, only manufacture to order.

Cheap v. Good Tools.

As a rule, cheap tools are not good, neither are good tools cheap. Two quotations, given by different makers but to the same specification, vary as much as from 50 to 100 per cent., and yet as much is expected from the lower priced tool as from the higher one. There are many works at the present time which would do the same turnover at less expense if they replaced their present plant of old-fashioned tools by half the number of modern machines.

In America, it is the general practice not to repair tools, but when they show signs of wear to replace them by new machines.

Too much stress cannot be laid upon the advantage of good tools.

Conclusion.

The author, in closing his paper, desires to thank those who have assisted him, and regrets that want of space has compelled him to omit reference to many important tools.

He trusts that the information given may be of some assistance in helping to a fuller acquaintance with a department of the engineering profession which demands constant attention.

THE INSTALLATION OF STEAM BOILERS.

V.

Strictly speaking, on grounds of safety, a high pressure steam boiler should have no holes cut in it; but some are absolutely necessary. These should not be unduly large, and, if necessary, the plate cut away ought to be so far made good that the boiler may not be weakened below the strength of the longitudinal seams. Such small holes as are cut for the mounting blocks of safety valves are stiffened by the steel mounting block itself, reinforced when necessary by rings of plate. For the larger holes cut for the steam outlet or junction valve, a stout reinforcing ring must necessarily be placed inside the boiler. The internal diameter of the manhole mouthpiece is 16 inches. This implies a hole of 19 inches diameter cut in the shell plate, a very serious gap which needs careful reinforcement. Up to 100 lbs. pressure this may, perhaps, be sufficiently provided by the steel mouthpiece itself, about $\frac{3}{4}$ inch thick on its riveted flange, and by an internal treble riveted ring of equal strength. For higher pressures, however, it is necessary to better distribute the stress, and for this purpose the whole of the boiler crown is doubled at this particular manhole plate by the addition of a rectangular plate extending considerably on each side of the manhole mouthpiece.

It must be considered that the stress that would be carried by the 19 inches of the plate cut away will be concentrated on the edges of the hole just at the crown of the boiler. The use of the long and wide reinforcing plate is to prevent this concentration upon the plate edges, and distribute it upon the whole of the added plate section, the net undrilled area of which, taken along the longitudinal of the boiler crown, must exceed the area of the cut-away portion. In fig. 11 is shown the manhole mouthpiece in section with the boiler crown and reinforcing plate, and in fig. 12 the mudhole mouthpiece, whose duty it is to remain flat under the heavy pressure, and to strengthen the lower part of the front end plate where no central gusset stay is possible. The mudhole has an inside cover held by two bolts, and this and the mouthpiece are made particularly stout. The opening usually measures 15 inches × 11 inches, to admit a man.

A light external cover is usually added as a finish to conceal the bolts of the inside cover. The propriety of such covers is a matter of opinion. It is questionable whether good mechanical work can be improved by covering it up by false covers, serving no purpose of protection or strength.

It is usual to employ steam junction valves of 6 inches diameter. This is still the practice with pressures of 150 lbs., and yet it was only considered necessary when pressures were 100 lbs. Some years ago a committee sat on safety valves—not literally, be it said, but figuratively, and in the way of inquiry. They investigated safety valves on the basis of certain facts relative to steam outflow. We need not at this moment discuss the question of steam outflow, but for the present purpose we may agree that the weight of steam flowing through a given opening will vary with the absolute pressure. This is equivalent to saying that three times as much steam at 90 lbs. pressure will flow through a given opening as will flow at 30 lbs. pressure. Now, it is well recognised that at all pressures the evaporative capacity of a steam boiler remains practically unchanged. Such being the case, it follows that high pressure boilers require correspondingly less outlets for steam than do low pressure

boilers. At 160 lbs. absolute pressure a 2-inch safety valve will pass as much steam as will flow through a 4-inch valve at 40 lbs. pressure. Consequently, if a 6-inch junction valve

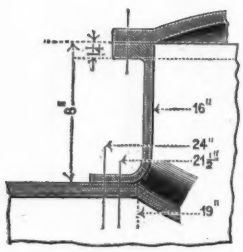

Fig. 11.

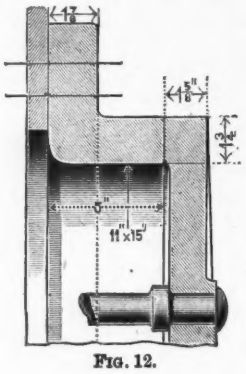

Fig. 12.

be large enough for 100 lbs. (115 lbs. absolute) a 5-inch valve is big enough for an absolute pressure of 165 lbs., and a 6-inch valve should amply provide steam outlet from an 8 feet boiler at 150 lbs. gauge pressure.

The tendency is to use valves too large, forgetting the findings of committee on safety valves which were very carefully worked out, and to which we hope to draw more particular attention in the near future. One other external mounting block demands particular attention, for it is often made too small and slight. This is the blow-out. Though only 2½ inches diameter at the blow-out tap, the elbow pipe tapers gradually larger towards the boiler, where it should be 5 inches inside diameter, so as to be stiff and strong to resist possible stresses which are brought upon it by the careless use of the blow-off key, &c. Such an elbow pipe of cast-steel is shown in fig. 13, with its stiffening flange. The

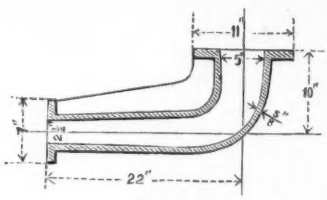

Fig. 13.

depth of 10 inches must be such as, with the mounting block of 7 inches projection, will bring the blow-out tap itself below the hearth pit cover plates, these being at least 1 inch below the edge of the front end plate. The blow-off block itself is about 15 inches from the face of the front end plate. This brings the centre of the blow-out tap about 12 inches in front of the boiler.

The cutting completely away of a 19-inch circle for the manhole of a high pressure boiler cannot be looked upon as satisfactory practice. It is usual, and precedent appears sufficient to justify many bad practices. We have seen better practice in similar situations, which might well receive the attention of high-class boiler-makers, with a view to a modification of the present system. The practice we have in mind was, if we remember rightly, first carried out by an

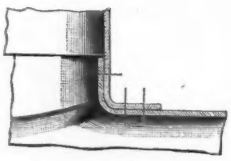

Fig. 14.

American boiler works, and consisted in cutting the hole for a dome manhole something like 6 or 8 inches smaller than the intended opening, and flanging up the edges. The final connection was somewhat as in fig. 14. In this method of construction there was no plate edge at the point of possible concentration of stress, but merely the rounded bend of the upward flange. An extra row of rivets was got in round this flange, and nothing in the arrangement precludes the use of a further reinforcing ring on the inside of the shell, just as in ordinary practice. For an opening of 16 inches the piece cut away would be about 10 inches only, and the flanging would reduce the upper edge of the flange to about five-eighths that of the plate, but at the angle of the bend the reduction would be very slight.

Having now considered the shell and its external attachments, the furnace tubes next demand attention.

(To be continued.)

HUMPAGE'S GEARING.

Some time ago we printed a short note on the subject of this mechanism. Recently Messrs. J. C. Howell & Co., of 24, Queen Victoria Street, brought it again under our notice, and have given us more information about its development.

Fig. 1.

It is a mechanism so curiously well adapted to a particular and extremely useful purpose, and the geometrical movement is at the same time so intricate, that we think a fuller description of it will interest our readers.

The gearing was originally designed to replace the back gearing of a lathe head, and was contained in the cone pulley. It has, we understand, been extensively used for

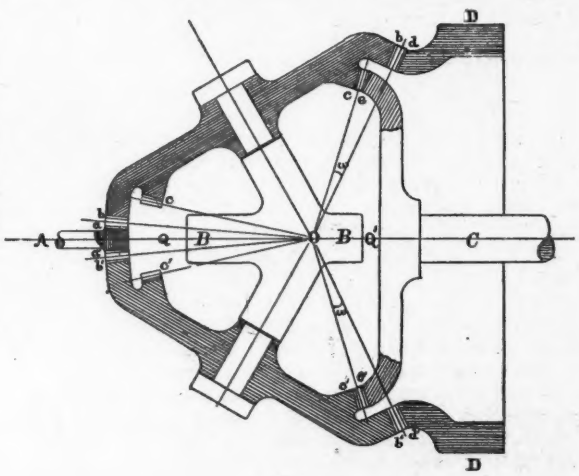

Fig. 2.

this purpose, but there seems to be an indefinite field for its employment wherever motion is to be transmitted from one shaft to another in the same line with a change of speed.

The change of speed may be quite small, say, 2 or 3 times, or it may be very large, 200 or 300 times, with surprisingly little difference in the numbers of the teeth employed, and these numbers are in almost any case very moderate. The wheels may be arranged in such a way that there is no strain or pressure upon any bearing in the gear except the small end thrust due to the interaction of pairs of bevel wheels. The construction lends itself readily to, and almost necessitates, complete enclosure in a case which forms a convenient oil bath. The dimensions of the whole gearing are very moderate and the arrangement is compact. The very construction of the gear provides a convenient means of gradually throwing the load of the driven shaft on to the driver, running at full speed, by what is equivalent to a slipping friction clutch. It is evident that a mechanism which appears to meet so completely the particular difficulties of driving heavy slow running machinery from a light fast running electrical motor is worth some attention.

Fig. 1 is a view of a Humpage's gearing for transmitting 30 H.P. with a reduction of speed as between the driver and driven shafts of 1,400 to 70. Its actual dimensions can be judged from the size of the largest fixed wheel on the right, which is 24 inches in diameter. The dowels seen in the large disc belong to a cast-iron cover placed over the whole gear forming an oil bath. The driving axle, that on the left, passes through a bearing in the end of the cover, and is thereby kept in a central position. The driven axle, that on the right, runs in a bearing in the large disc.

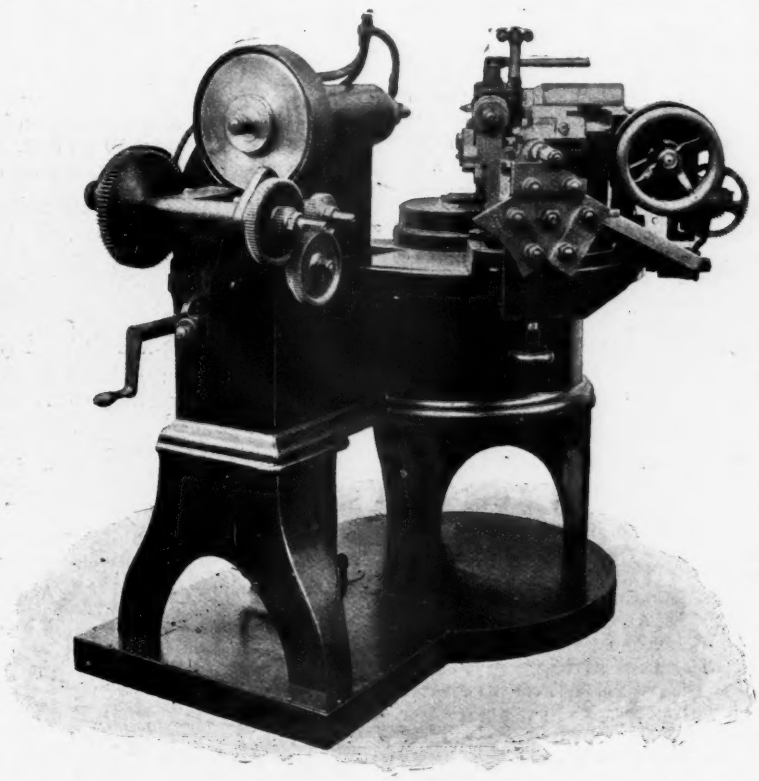

Fig. 3.

The action of the gear will be clearly seen by reference to fig. 2. In this diagram the driving shaft, A, carries a bevel wheel, $a\ a'$. On a piece, B B, which is free to move about the axis, Q Q', are carried two pairs of bevel wheels, $b\ b$, $c\ c$, $b'\ b'$, $c'\ c'$, each pair being made in one piece free to turn on an axle fixed in B B and carried round with it as it turns about Q Q'. $b\ b$, $b'\ b'$, gear with $a\ a'$, and also with a fixed wheel, $d\ d'$, while $c\ c$, $c'\ c'$ gear with a wheel, $e\ e'$, on the driven axle C.

If the numbers of teeth in the wheels are $a\ b\ c\ d\ e$ respectively, the ratio of the speed of A to the speed of C is $\left(\frac{b}{d} + \frac{b}{a}\right) \div \left(\frac{b}{d} - \frac{c}{e}\right)$. For large speed reductions b should be large compared with a and d, and $\frac{b}{d}$ should nearly equal $\frac{c}{e}$. It would be inconvenient in practice to make d small, but a may be small compared to b, and $\frac{b}{d}$ may be nearly equal to $\frac{c}{e}$. Indeed, it is the possibility of making these last two nearly equal that gives to this and other differential gearings their great range of possible reduction.

In fig. 2, $\frac{b}{d} = \cdot 9$, $\frac{b}{a} = 10$, $\frac{c}{e} = \cdot 75$, and the speed reduction ratio is about 73.

In the arrangement of fig. 2, moreover, the contact points between wheels a and b, between wheels b and d, and between wheels c and e, are in a straight line, so that there is no pressure on the journal of $b\ b$, $c\ c$, beyond that due to the outward thrust of the bevels. From the symmetry of the arrangement it is clear that no side pressure is thrown on the bearings of the axles, A, C, by the action of the gear.

If the wheel $d\ d'$, instead of being fixed, turns freely in a collar, the part B B will run round without driving C. If D D be carried in a clamp, and the motor driving the shaft, A, be started to full speed with the clamp loose, the load can be thrown gradually on to A by slowly tightening the clamp. The peculiar facility for this operation afforded by the gear will greatly increase its field of application.

The mechanical construction affords many pretty problems. It is clearly a machine which will repay the cost of very accurate construction, and Messrs. Howell and Co. are fully alive to this. Machines have only recently been available for cutting accurate bevel gears, and the very best makers of gears, even in America, have been content with the rough approximation to the geometrical form obtained by cutting the teeth with parallel cutters, and doing something or other afterwards to make them look a little better. In a pair of correct bevel wheels every generating line of every tooth in both wheels converges to a single point—the wheel centre—and the section of every tooth is of the same shape at every point, only differing in scale. Such teeth can only be machined by a tool moving always in a direction which passes through the wheel centre. Machines for producing bevel wheels in this way are now manufactured by the Gleason Tool Company, of Rochester, New York, and Messrs. Howell & Co. employ the machine shown in fig. 3 for cutting their wheels. In this machine the wheel centre is over the middle of the circular bed seen on the right. The wheel to be cut is carried on the large horizontal mandrel of the left, which points directly to the wheel centre. The planing tool is carried on a slide which is directed to the centre and can be placed in any altitude or azimuth. The form of the tooth planed out is determined by the steel template fixed in the front of the machine as it is seen in this view. It may be observed that the Gleason machine will form the hyperboloid of revolution as easily as the cone, and the teeth formed on this surface will gear in the same way as the spiral teeth used so much for large power gears.

When the wheels are assembled as in fig. 2, all their centres should coincide at the point O. To secure this, very accurate machining will be required, but if the gears are to run

quietly and easily it is quite indispensable. With really accurate machining and suitable materials extremely good results ought to be obtained.

GLASGOW TRACTION CONTRACTS.

The Glasgow Corporation have recently asked electrical firms for tenders for the following plant for the tramways :—

Four 2,500-kw. 6,500-volt three-phase generators, suitable for mounting on engine crankshaft. Speed, 75 revolutions per minute.
Two 600-kw. 600-volt dynamos, suitable for mounting on engine crankshaft. Speed, 90 revolutions per minute.
160 100-kw. oil transformers, to work at 25 cycles per second.
Six 50-kw. 100-volt exciter dynamos, to run at 300 revolutions per minute.
24 rotary converters and boosters combined, with spare armatures, field spools, &c.

It will be seen that this is one of the most important electrical contracts which has thus far been put out to public tender in this country, and it will be a very great pity indeed if the work goes abroad.

We fear, however, that some of the sections will have to be placed in America, as it is questionable whether any firm in this country is in a position to undertake the design and construction of *four* three-phase generators of 2,500 kw. within the 12 months allowed for delivery. In the case of the rotary converters again, the work will probably be given to a foreign firm who have the necessary experience in this particular class of machine. The rest of the apparatus—auxiliary dynamos, transformers, and exciter dynamos—is, however, well within the capacity of British firms, and we trust that the Glasgow Corporation will do their best to keep the work on this side. Where there is only a small difference in the amount of tenders it would only be fair to give home manufacturers the benefit.

This matter of placing contracts abroad is a most important one, because the effect is cumulative; the more work given out, the more experience do our competitors gain, and the worse it is for British firms.

We are glad to see that the specifications are drawn up clearly and concisely (rather an unusual thing nowadays), but are afraid that unless an easy view is taken of the penalty clause, there is likely to be trouble. £25 per day on each section of the specification seems to us just a little too severe. Suppose, for example, that a firm undertook the exciter generators at £2,500, on which, under ordinary conditions, they could make £300 profit. Then, if they were so unfortunate as to be 12 days late in the delivery of the first generator, the penalty on that alone would swamp all their profit on the six machines, while if they were late with the rest they would actually have to pay the Glasgow Corporation a large sum to take the machines off their hands. It seems to us that the regulation penalty of 1 per cent. per week is quite strict enough.

RETURN FEEDERS FOR ELECTRIC RAILWAYS.

(*Continued from Vol.* 44, *page* 326.)

If the central station is situated at the middle of the track, the line may be looked upon as two lines with the central station at one terminus, such as we have considered above. The volume of copper in this case may be obtained by substituting in the proper formula, for C and L, half their values.

$$\Sigma\,(\text{vol.}) = \frac{\frac{C}{2}\left(\frac{L}{2}\right)^2}{3\,K\,\Delta} + \frac{\frac{C}{2}\left(\frac{L}{2}\right)^2}{6\,(m+1)^2\,K\,\Delta} = \frac{C\,L}{24\,K\,\Delta} + \frac{C\,L}{48\,(m+1)^2\,K\,\Delta}.$$

The quantity of copper in the cables is, therefore, only $\frac{1}{8}$th of that required in the former case.

We have still the case to consider, where the track forms a semi-circle with the central station at its centre. Let the two cables connecting the central station to the termini of the line be called end cables; and let m intermediate cables be connected at equal intervals. By these m return cables the line is divided into $m + 1$ equal parts, and the current in each is :

$$c_m = \frac{C}{m+1}.$$

The end cables carry each a current half this amount.

Since the lengths of all the return cables are equal, their total cross-sections will be given by the formula

$$\Sigma\,(s) = \frac{C}{m+1}\,\frac{l}{K\,\Delta}\,m + 2\,\frac{C}{2\,(m+1)}\cdot\frac{l}{K\,\Delta} = \frac{C\,l}{(m+1)\,K\,\Delta}\,\{m+1\} = \frac{C\,l}{K\,\Delta}.$$

Therefore the sum of the cross-sections of the cables is also in this case a constant, and is independent of the number of the cables. Since $l = \frac{L}{\pi}$,

$$\Sigma\,(s) = \frac{C\,L}{\pi\,K\,\Delta},$$

and the total cross-section is less than in the first case in the ratio $2 : \pi$, that is, about 50 per cent.

The volume of the copper, in this case, may be calculated by considering that for an intermediate cable it is $\frac{C}{m+1}\,\frac{l^2}{K\,\Delta}$, and for an end cable $\frac{C}{2\,(m+1)}\cdot\frac{l^2}{\Sigma\,\Delta}$; therefore

$$\Sigma\,(\text{vol.}) = \frac{C\,l^2}{(m+1)\,K\,\Delta}\,m + 2\,\frac{C\,l^2}{2\,(m+1)\,K\,\Delta} = \frac{C\,l^2}{K\,\Delta}$$

In this, evidently, the volume of copper is constant whatever the number of the end cables. If we substitute for l its value $\frac{L}{\pi}$

$$\Sigma\,(\text{vol.}) = \frac{C\,L^2}{\pi^2\,K\,\Delta}.$$

For comparison, note that the volume of copper for a straight line with the central at one end is

$$\Sigma\,(\text{vol.}) = \frac{C\,L^2}{3\,K\,\Delta},$$

i.e., the copper in cables for the semi-circular line is about 0·3 of that in the straight line.

The case in which the line forms a complete circle with the power station in the centre is important in connection with closed circular lines in cities. Let L be the circumference of such a line and l its radius. Let there be m return feeders at equal intervals running from the line to the central power station. Each of these feeders will carry a current $\frac{C}{m}$; and the cross-section of one cable will be

$$s = \frac{C}{m}\cdot\frac{l}{K\,\Delta}$$

and for m cables

$$\Sigma\,(s) = \frac{C\,L}{2\,\pi\,K\,\Delta}.$$

The total volume of copper is

$$\Sigma\,(\text{vol.}) = \frac{C\,l^2}{K\,\Delta} = \frac{C\,L^2}{4\,\pi^2\,K\,\Delta}$$

In this case also, both the total section and the total volume of the copper are constant quantities, independent of the number of cables.

For the straight line with an infinite number of return feeders, as we have seen above, the total copper volume is

$$\Sigma\,(\text{vol.}) = \frac{C\,L^2}{3\,K\,\Delta}$$

Comparing this with the volume for the circular line, namely, $\frac{C\,L^2}{4\,\pi^2\,K\,\Delta}$, we can see that the latter is only about $\frac{3}{40}$ths of the former.

III.—Example for Calculation.

As an example, take a case where the central station is at one end of the line. Let C = 540 amperes; L = 18 km.; let there be a loss of potential in the cables of 30 volts; assume for simplicity that the conductivity of the copper K = 60; then

$$\Sigma(s) = \frac{C\,L}{2\,K\,\Delta} = \frac{540 \times 18{,}000}{2 \times 60 \times 30} = 2{,}700 \text{ mm}^2.$$

This must be the section of a single return feeder from the terminus, or it must be equal to the sum of the cross-sections of any number of return feeders. This we shall prove arithmetically. One cable at the terminus has to take off half the current, *i.e.*, 270 amperes, and therefore its section must be

$$S = \frac{270 \times 18{,}000}{60 \times 30} = 2{,}700 \text{ mm}^2.$$

If an intermediate cable 9 km. in length is applied, this must take off 270 amperes, while 135 amperes are taken by the end cable, the remaining 135 amperes flowing through the rails to the central station. Therefore,

$$S = S_1 + S_2 = \frac{270 \times 9{,}000}{60 \times 30} + \frac{135 \times 18{,}000}{60 \times 30}$$

$$= 1{,}350 + 1{,}350 = 2{,}700 \text{ mm}^2.$$

The quantity of copper for one return cable from the terminus, since in this case $m = 0$, is

$$\Sigma(\text{vol.}) = \frac{540 \times 18{,}000 \times 18}{3 \times 60 \times 30} + \frac{540 \times 18{,}000 \times 18}{6 \times 60 \times 30}$$

$$= 32{,}400 + 16{,}200 = 48{,}600 \text{ dcm}^3.$$

We obtain the same value if we multiply the cross-section calculated above, by the length; for 2,700 mm² × 18 km. = 48,600 dcm³.

For one intermediate and one end cable $m = 1$, therefore

$$\Sigma(\text{vol.}) = \frac{540 \times 18{,}000 \times 18}{3 \times 60 \times 30} + \frac{540 \times 18{,}000 \times 18}{6 \times 2^2 \times 60 \times 30}$$

$$= 32{,}400 + 4{,}050 = 36{,}450 \text{ dcm}^3.$$

If, now, the sections found above are multiplied by the corresponding lengths, we obtain

$$\Sigma(\text{vol}) = 1{,}350 \times 9 + 1{,}350 \times 18 = 12{,}150 + 24{,}300 = 36{,}400 \text{ dcm}^3.$$

With nine intermediate cables the second member of the expression has only the value 162 dcm³, and amounts therefore to only 0·5 per cent. of the first member.

For the semi-circular line we get—

$$\Sigma(s) = \frac{540 \times 18{,}000}{\pi \times 60 \times 30} = 1{,}720 \text{ mm}^2$$

and

$$\Sigma(\text{vol.}) = \frac{540 \times 18 \times 18{,}000}{\pi^2 \times 60 \times 30} = 9{,}848 \text{ dcm}^3.$$

For the circular line we get—

$$\Sigma(s) = \frac{540 \times 18{,}000}{2\,\pi \times 60 \times 30} = 860 \text{ mm}^2$$

and

$$\Sigma(\text{vol.}) = \frac{540 \times 18 \times 18{,}000}{4\,\pi^2 \times 60 \times 30} = 2{,}462 \text{ dcm}^3.$$

These examples may serve to establish the correctness of the formulæ arrived at by the investigation.

(To be continued.)

RENEWABLE INCANDESCENT LAMPS.

Our pages have from time to time borne witness to the desire on the part of inventors to devise a method of replacing used or broken filaments in the bulbs of incandescent lamps. Apparently a serious attempt is now about to be made to carry out this idea in practice under the patent No. 23,623 of 1897, granted to Messrs. Charles Howard and Richard Mayer, for which purpose a company is being floated under the title of "The Renewable Electric Lamp Company, Limited," having as directors Messrs. Jacob Atherton, M. F. Armstrong, J. E. Touch, M.I.M.E., and H. E. Kershaw, with Sir W. H. Preece and Major Cardew as consulting engineers. We certainly wish well to any enterprise which by its operations will tend to assist the consumer or reduce the cost of electric lighting, and this company claims to be able to turn out lamps at 6d. each, or "at not more than the price of other first-class lamps of English manufacture with a guarantee for their renewal at about half the original cost." Assuming that this forecast be verified when the time comes to do business, everyone connected with the industry, save, perhaps, competing lamp manufacturers, will have reason to be grateful to those gentlemen whose names are given above, even if they have fixed the purchase consideration at such a high figure as £100,000.

In connection with the company's proposals, however, there are certain statements that require somewhat careful consideration. Everything depends upon the relative value of the materials used in manufacture, and the cost of labour in effecting renewals. An ordinary lamp is regarded as having reached the "smashing point" when either the filament is broken, or the bulb is internally coated with deposited carbon to such an extent that the light emitted is seriously reduced.

We are told that by the company's process, when the filament becomes burnt out, the glass neck of the bulb is cut, the wires supporting the filament detached, a new filament is inserted, and the two parts of the glass bulb are fused together again, the bulb being finally exhausted in the usual way. It is claimed that "the whole of the material originally used is saved as well as the cost of manufacture." It has always been stated by lamp makers that the cost of material is trifling compared with the plant and establishment charges, the cost of exhaustion and general labour charges. Inasmuch as the filament is replaced, it is difficult to see exactly where the promised economy comes in, but the interesting point of how a blackened bulb is cleaned is not referred to at all. Of course, if the company can do what they profess to be able to do, well and good, but exactly the same claims have been made over and over again by inventors whose "renewed" lamps have been heard of but never seen.

One of the peculiarities of the special lamp made by the company (which alone—judging from the prospectus—will be "renewed" by the process) is an elongated neck to the bulb. Mr. Manville, in his report, states that this "should enable the lamp to work at a greater efficiency" than others, because it keeps the lampholder cool. Exactly what this has to do with the efficiency of the lamp (*i.e.*, with the emissivity of the filament), he does not explain, and it is, indeed, difficult to see what he is referring to in making the statement.

Mr. Newton Russell, of Shoreditch, follows by another remark that "a great saving will be effected, both in efficiency of candle-power and current consumed." Why? Unless the filaments are of an improved or better material or form the efficiency must be something like that of lamps our readers are well acquainted with, and nothing is said about a new material or method of treating the filament.

We can only hope that the main claim will be realised; that lamps can be effectively renewed at half their original cost. True, the cost of lamp replacements at present does not exceed 10 per cent. of the energy consumed; a lamp costing 1s. will, during its life-time, consume about 10s. worth of electrical energy; say a total of 11s. for 600 hours lighting, but few consumers will have any objection to reduce this figure to 10s. 6d. The public must, however, by this time be aware that an efficient lamp is far more important than a cheap lamp, and it is to be hoped that "renewed" lamps will not sacrifice efficiency for renewal "at a nominal cost." Frequent replacement will, however, be possible if the company finds its process a success, and this is the most pleasing expectation, for at present a majority of the lamps to be seen in use have reached their "smashing point," and it would pay to replace them more frequently (and gain, therefore, indirectly in efficiency) by the better light that would be obtained.

We will conclude what little space permits us to say by asking a question, Why has the company so timed its subscription list, by closing on a Thursday, that the comments of the technical press cannot possibly be read by intending investors?

REVIEWS.

Mechanics Applied to Engineering. By John Goodman. London: Longmans, Green & Co. 1899. 7s. 6d.

This book has been written for those already possessing a fair knowledge of theoretical mechanics and elementary mathematics, and the author states that the book should be useful to those intending to enter the Inst.C.E., or to obtain B.Sc. and B.A. degrees in engineering and others.

On the whole, the book is a good practical work. We should like to hear more on the subject of ball bearings. The author condemns the theoretically perfect angular grooves, and advocates a curved groove of larger radius than the balls as better in practice. Generally, he deals with principles, however, rather than practice, but the section on friction is good and full, and we are glad to note a frank recognition of the experiments of Wohler on stress repetition, especially as these have been far too little appreciated.

In the appendix will be found a short treatment of the operations of differentiating and integrating with a view to encouraging engineers to take up the study of this subject. It is a little difficult to see why there should be such a multiplicity of books on mechanics. They are all more or less the same in subject, if slightly different in treatment. The great multiplicity of books is in the mechanical line. We like Mr. Goodman's methods and his arrangements, and could wish that some as practical a professor would undertake to deal with the physics and chemistry of engineering.

Text-Book of Mechanical Engineering. By W. I. Lineham. Third Edition. London: Chapman & Hall. 1898. 12s. 6d.

The author of this book has certainly been singularly successful in hitting the mark at which he aims, namely, to condense into one volume a rational *précis* of the whole theory and practice of mechanical engineering. He has accomplished this end in a manner that we should have hardly believed possible. True, he fills over 900 pages, but this is not an enormous space into which to compress so much, and, on the whole, so correct a compression. The padding is reduced to a minimum, and there is an entire absence of mere pictorial representations of machinery which make some books little better than trader's advertisements.

Mr. Lineham's illustrations are genuine explanatory sketches. Where perspective has been employed, its use has been justified as giving a better view than a working drawing would do, but generally the illustrations are not far removed from being working drawings. From them a fair designer would quickly make a working drawing, or a pattern maker would make a pattern.

Workshop methods are briefly but clearly described. There is even a brief account of iron smelting and steel making, and other processes of metallurgy. There are good descriptions and illustrations of smith work, but we do not think the author happy in his description of the forging of a bent crank. It may be done with very small cranks on the system he describes, by means of a pair of dies, but the usual method is quite different. The straight bar is first jumped thicker at the places where the bends will come, and the bar is then bent by a system which puts in two bends at one time, and involves an altogether different process from that described by the author.

We think, also, that Regnault's law, that the specific heat of a gas is constant at all temperatures, should be qualified. This is not now held to be a fact. Berthelot has shown the variation of specific heat, especially at temperatures beyond 1,600° C., and we think, also, it is a mistake to quote a fixed ratio between specific heat at constant volume and constant pressure. It is usual, and Rankine did it, to state the ratio for air as $\gamma = \frac{c_p}{c_v} = 1{\cdot}40\ v$, or, approximately, 1·41, or $\frac{\cdot 2375}{\cdot 1686}$. The molecular heat of a gas is, for the two conditions, about 6 8 and 4·8, the difference being 2 (metric system), or, more accurately, 1·94. Thus c_p is not really $c_v \times x$, but rather $c_v + x$. The quantity, x, is the external work done by a gas in occupying a larger space when its temperature is raised 1°, and it is an equal quantity for each degree of increment. It appears probable that all true gases have the same difference, x, and that variations observed in the ratio, $c_p : c_v$, are only such as are due to the fact that some of the gases are really very close to their points of liquefaction. The so-called perfect gases all behave nearly alike.

The treatment of the steam engine is good and sound, but we do not care for the author's description of the history of superheating as anomalous. He says the curious anomaly occurs that a 5 per cent. extra heat supply will often eliminate a 20 per cent. loss. There is nothing either curious or anomalous in this. Engineers have long recognised that the loss in a cylinder is very largely the evaporation which occurs during the exhaust stroke, and it is an obvious truism that a cylinder cannot be robbed of heat by evaporation of water, if no water is present to evaporate, and therefore any little additional heat which will serve to reduce condensation will be cumulative in its action. Indeed, it appears very probable that if the superheat be a little in excess of the condensation due to work, the greater part of the advantage of superheat will be secured. Entropy is briefly treated upon in the additions, which take the form of appendices, and there is added material on high speed engines, turbines, evaporative condensers, and upon defects in boilers, scale, feed heaters and filters, fuel and draught mechanical stokers, and gas engines, as well as gas producers.

We need scarcely say that full treatment of any subject is not attempted, but the author has been very successful in his selection of matter. There is one thing he might have done more. He might have given, however invidious may have been the task, a selection of books dealing more fully with the various items, so that any student wishing specially full treatment of a particular subject, would have a guide to the means of finding it. We feel sure Mr. Lineham would be generally correct in his choice.

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15 *Lezioni sperimentali su la Luce considerata come fenomeno elettromagnetico.* By A. Garbasso, lecturer on mathematical physics at the University of Pisa. Milan: The office of *Revista l'Elettricita.*

This is a reprint of a course of lectures delivered at Pisa to an unadvanced class, the object of which was to give by a course of experiment and explanation, without mathematical discussion, a connected and consecutive account of the theory of the electro-magnetic ether. Many scientific conceptions, which are now accessible only by mathematicians, will undoubtedly and before long become part of the common stock of knowledge and ideas, just as have the ideas of the conservation of energy, or the resolution of periodic functions within recent years. Among such ideas are Maxwell's of the vector potential and the electro-magnetic theory of light, which are now almost exclusively the property of the mathematicians. Though we appreciate its aim, it does not seem that the book before us is sufficiently well done for the purpose. It is poorly expressed in a colloquial style, and its cheap get up indicates the publishers' opinion of its importance. The material, however, is there, is well arranged, and fairly deals with the more obvious properties of light on the electro-magnetic basis, and it might be of assistance to a lecturer preparing a course on this subject.

Il Montatore Elettricista. By E. Barni. Fourth edition, revised and enlarged. Milan: The office of *Rivista l'Elettricita.*

This is a very complete hand-book for a working electrical engineer, and is freely illustrated. The information is of an elementary character, but on glancing through it all the general information that would be required by a workman erecting, or in charge of, an electrical installation seems to be clearly and easily given. At 1 lira in a paper cover it is certainly very inexpensive.

Journal of the Institution of Electrical Engineers, No. 140.

The principal contents of this number are as follows:—"A Rotary Converter," by Prof. E. Wilson; "The Effect

of Governors on the Parallel Running of Alternators," by Leonard Wilson; "The Hissing of the Electric Arc," by Mrs. Ayrton; discussion on Messrs. W. Duddell and E. W. Marchant's paper on "Experiments on Alternate Current Arcs by Aid of Oscillographs."

THE REPORT OF THE PACIFIC CABLE COMMITTEE.

(*Continued from page* 154.)

In the preceding table a noticeable feature is the difference in the estimated length of the cable when laid. Taking the two extremes we find that in the case of the Eastern Company and the Post Office, there is an excess of length over the Henley Company's assumed estimate, as great as 315 miles, which would mean in the case of similar cores, a reduction of 14 letters per minute, or, say, 19 per cent. in the carrying capacity of the cable. It is also noticeable that the greater lengths are those supplied by the Eastern Telegraph Company and the Post Office. The manufacturing companies, who in the course of their business have much more experience than either of these two, although they differ each from each, are all considerably under the Eastern Company and the Post Office in the lengths given. This difference to a great extent is due to the varying amount of slack, 10 per cent. at most is the figure given by those with the greatest experience of the subject. Several cables in the Atlantic have been laid with 10 per cent. or less of slack, and we do not know of any sufficient reason why the same should not be the case in the Pacific. It is true that in the Atlantic this percentage used to be exceeded, but, with increasing knowledge, and with an improved type of cable and adequate machinery, this has been modified, very much to the advantage of those who own the cables, as the diminution in length means a corresponding increase in the carrying power of these cables. We have chosen the length of 3,600 miles in the table given, as this is the length taken by Dr. Muirhead, who is an acknowledged authority on the subject of the carrying capabilities of cables. Dr. Muirhead points out that the ability and experience of the clerk receiving the message is of much importance, as this governs the amount of the definition in the signals which is requisite for legibility. Thus, taking the core of 500/320, 3,600 miles in length, we are told that by using the automatic curb method of transmission as many as 90 letters (18 "words") per minute *can* be deciphered, but that the limit of speed under the same conditions, with an average clerk, would be 76 letters per minute working simplex (Mr. Siemens gives this in his evidence as 75 letters), or 70 letters each way if using the duplex method of transmission. With the core 552/368 for the same length and by the same methods, 87 letters (17·4 "words") would be transmitted simplex, and a total of 160 letters (32 "words" per minute) if working duplex. It is obvious that the duplex method with automatic curb transmission should be adopted over this long section. In speaking of the core 650/400, Dr. Muirhead says that "working with the same signals as you would get with the proposed cable of 500 copper and 320 gutta-percha at the rate of 70 letters per minute, a speed of 95 letters by automatic curb transmission, of 64½ by the ordinary method of transmission," could be obtained. Dr. Muirhead states elsewhere in his evidence, that by the introduction of the automatic curb system an increase of more than 40 per cent. in speed has been obtained, as compared with the ordinary method of transmission. For the core 650/400 over a length of 3,650 miles, Mr. Lucas takes the speed as 70 letters per minute; this is presumably without automatic curb transmission. Sir W. H. Preece, in speaking of the 650/400 core over a length of 3,628 miles, calculates a speed equal to nearly 63 letters per minute. We are afraid that this and the other calculations which the same authority gives *re* speeds are founded on an erroneous basis, as for the purposes of this calculation Sir W. H. Preece says that he has taken the two 1884 Atlantic cables of the Commercial Company, each of which had a core of 350/300 and a united length of 4,699 miles, whereas the two cables which when united for the purpose of experiment gave the speed result he deals with, had a length of 4,512 miles, which looks as if the Southern one of the 1884 cables, which is 2,353 miles long, had been united with the 1894 Commercial cable, which is 2,161 miles long, the total length of these being 4,514, but the core of the newer cable being 500/320 instead of 350/300. If we are correct in our supposition, and apart from the evidence given by Mr. F. Ward, the figure mentioned as the total united length, seems to indicate this, Sir W. H. Preece's figures, which he says were based on a core of 350/300 throughout, must be fallacious. The representatives of the Eastern Company give the speed over a 650/400 core, presumably 3,795 miles long, as being 70 letters per minute. For a core 800/550 and a length of 3,628 Mr. Lamb gives (on the authority of Sir W. H. Preece) a carrying capacity of 85·6 letters per minute. Over a core of 550/350 Mr. Carson is of opinion that 80 letters could be carried. Mr. R. K. Gray gives 62 letters as the speed over 3,560 miles with a core of 552/368.

Besides the actual number of words or letters which a cable will carry, there arises in relation to possible revenue, or earning power, the question of how many letters go to the average word actually transmitted, and what proportion of unpaid-for words are necessarily transmitted in connection with the organisation of the cable, either as indications, &c., on the messages, or as service messages connected with the management of the line? It is obvious that the proportion of this dead traffic depends to a great extent, among other things, on the ability with which the cable in question is managed. Mr. Carson points out that on the trans-Atlantic cables under his control, the average length of the words transmitted is eight letters, and that of all the words which pass over these cables, 90 per cent. are paid for, and he estimates that on the Pacific cable, with a core of 550/350, and by using duplex, 10 paying words could be carried each way, or, say, 20 paying words per minute of eight letters each. Mr. Carson explained that his cables were worked on a specially arranged system of checking, and that his lines do not work under the rules of the International Convention.

As regards ordinary messages, the Commercial Cable Company find, according to a footnote attached to Mr. Ward's evidence, that 16 per cent. is the amount of dead work, or non-paying traffic carried over their cables. Mr. R. K. Gray found that out of 100 messages to and from South America, picked out at random, the average number of letters to the word was 6·03 in the body of the message, and that the non-paying words carried came to about 13 per cent. of the traffic.

Mr. Finch, the director-general of the Indo-European Telegraph Department of the Indian Government, which works in joint-purse agreement with the Eastern Telegraph Company, and carries a considerable proportion of their traffic, gave the average number of letters to the word as eight ("seven or eight"), and an average of 12 or 13 paying words to the message. From this gentleman's evidence we find that the non-paying words due to administrative work and indications or messages, &c., come to 15 per cent. of the total traffic.

From this it will be seen that there is a fairly general agreement among the witnesses above referred to, as to the proportion of dead traffic carried over various cables, but the evidence which follows is of a different complexion. The representatives of the Eastern Company give 9·43 as the average number of words which is made up as explained by the following extract from the evidence:—

Q. 1,831. Could you explain exactly how you get at that 9·43?—Taking the ordinary Australasian traffic we find 473 words of Government messages, containing 2,652 letters, giving an average number of letters per word of 5·61. Then there are 2,608 Press words containing 16,185 letters, or an average number of letters per word of 6·21. Ordinary messages contained 44,664 words, or 341,332 letters, giving an average number of letters per word of 7·64 and the average taking all the words and letters together, comes out at 7·54. As the Government messages are carried at half rates, and Press messages at quarter rates, it is necessary to multiply the Government average by two, and the Press average by four, to arrive at the earning power of the cables at full rates. Consequently, the average length of fully paid words is 9 43 made up as follows:—Taking the percentages of the different classes of traffic (Government, Press and ordinary) for the whole year 1895, and multiplying the Government average by two, and the Press average by four, we find the Government messages work out at 11 22 number of letters; the Press 24·84; and taking the ordinary at 7·64, as above the net result is 9·43.

Rejecting, for the moment, the composite figure obtained, as above explained, we find that actually the average length of the word is 7·54. Basing his information on a month's actual traffic on the Aden-Bombay cable, the theoretical speed of which is given by Mr. Hesse as "about 150 letters per minute, the actual speed attained of payable letters during that month, there being 73 per cent. of loss through preambles, repetitions, service messages and delays through pausing in transmission." This is a very great difference from the figure given by the previous witnesses. It would almost seem as though the whole 24 hours had been taken into the calculation, although it is evident that this time cannot have been fully occupied. The Eastern Company say that the mean theoretical speed through from London to Australia, working simplex, is about 145 letters per minute, and that the paying letters actually carried would only be a quarter of that number, say, 36 letters. Such a result along the proposed Pacific cable would leave a margin of over 36 letters more, available for paying traffic, independent of the 15 per cent. of dead messages which would be required if the cable were worked by the method indicated by Mr. Carson.

CORRESPONDENCE.

200-volt Supply from the Consumers' Point of View.

Now that the pressure of supply to consumers' terminals has been, and is being, almost universally raised to 200—250 volts, have any central station engineers given a thought to the effect this has on both the convenience to their customers and the influence on the amount of their accounts?

I am not going into the question of less copper in the mains or a closer regulation of voltage in the distributing network. I simply look at the disadvantages it entails on the user as compared with a supply at 100—110 volts.

In the first instance we hear of lamps using 2½ watts per C.P. for 100-volt circuits. I think that 200-volt lamps use 4 watts or more.

At one time when the number of lamps on a system used to be counted in 16-C P. lamps, these were taken as 60-watt. Now in one publication at least, 8-C.P. lamps are taken as 35-watt, or much over 4 watts per C P.

Taking an average of 3 watts per C.P. for 100—110-volt lamps, and 4 watts per C.P. for 200—250-volt (and I believe this is below the actual average), it means an expenditure of one-third more for the same light on the increased voltage. Further, no practical commercial 2 or 3-C.P lamps are made for 200-volt circuits, but good 2-C.P. lamps for 100 volts can be bought from several makers, and in passages, stairways, &c., where a 2-C P. lamp would be sufficient, a customer has to use an 8 C P., entailing four times the cost, and, moreover, these are usually long-hour lamps. I mean lamps that are lighted at dusk and remain burning till the house is closed for the night.

I might also refer to the matter of arc lights on continuous current circuits. I take it, therefore, that for the sake of the central station all the consumers are penalised to the extent of at least 30 per cent. on their accounts, and at the same time have not the same advantages they would have with the lower pressure.

I surmise that they do not know this. When the undertakers are a company, they look to themselves, but in the case of a municipality, which is practically a co-operative supply, would not the 100—110-volt supply, and more copper in the mains, be best for the using ratepayer who is, in fact, a part proprietor of the central station and mains?

X.

Direct Reading Ohmmeter.

As agents for the American Electric Speciality Company of New York, we have been interested in Mr. Woodfin's letter in your issue of the 14th ult.

We are very glad to hear that Mr. Woodfin has found the ohmmeter "to be of great utility and convenience and really a great advance" on the ordinary Wheatstone's bridge. Of course it is not claimed that the ohmmeter is as accurate as a high-class bridge, but then no one would think of using such an instrument while up a ladder or hanging on to a column or girder. The ohmmeter is designed specially for testing rapidly and with reasonable accuracy in positions and circumstances where the ordinary bridge would be of no use, and judging from Mr. Woodfin's experience, the instrument is well adapted for the purpose.

We are bringing the suggested improvements before the attention of the makers.

In conclusion, may we congratulate Mr. Woodfin on his good fortune in being able to conduct his dynamo tests under such ideal conditions as are indicated in his letter.

Cooped up in a city office, and working in a temperature of about 90°, we can only look forward to the time when we shall be *disturbed* by the singing of a bird. Unfortunately, the telephone bell is a very inferior substitute.

Jas. Hartley & Co., Limited, of Manchester,
(Late Smith, Simpson & Co., Limited, Manchester.)

Renewable Electric Lamp Company, Limited.

I am not up in the patents on this subject, but I know of the many failures. The prospectus is evidently the work of a master, and makes the very best of that class of scheme, easily grasped from its apparent common sense by the public, and ranks with the recovery of tin from scrap metal, the making of "zinc white" to replace "white lead" from battery refuse, &c., and, in my opinion, is even more impracticable.

There is no mention as to the necessity of cleaning the old glass bulbs before they can be used again—a most difficult operation through the small and elongated neck, and not effective, as the cleansed bulb cannot be and is not as clear as the original untouched glass, and therefore there must be a loss in efficiency, rather than a gain. The breakages of the old bulbs during this process would be considerable.

The real crux is the breakage of the glass bulbs. The glass, after being used, appears to fatigue, or deteriorate, probably from the great heat necessarily used in forming the original lamp (in that process the glass bulb is kept tempered at every stage). During the life of the lamp the heating becomes unequal and the glass strained. Anyhow, it is the experience of manufacturers that about 75 per cent. of the old glass bulbs are broken in the attempt to use them again. It would be very unwise to attach new bulbs to the old glass ends.

The old caps require chemically treating, by dipping or otherwise, to clean them, particularly at the contacts. Detachable caps are not good, they will not stand the strain of the lamps when tight or set in the holders, and electrical engineers will not use them.

Connecting wires become brittle and weak at the last moment. The point of sealing on the filament becomes foul and useless.

Altogether I fail to see any real advantage. The cost, taking the failures into account, must be greater than the cost of entirely new lamps. Of course, actual experience is the only real guide as to this.

The existing lamp makers find it very difficult and a very heavy burden to deal with so many classes of lamps, some hundreds of varieties, and even the largest of the lamp companies hardly pay. This new company proposes in addition to collect odds and ends of broken lamps, and possibly customers' experimental purchases, and match them and make them into new lamps. In my opinion this will handicap them most seriously, and it is highly probable they will soon drop the renewing business.

It takes a year or two to find out (even in the best equipped factory) how to make good lamps, and it takes an immense amount of pushing and advertising to start a new lamp business, whilst the factory expenses are out of all proportion to the first two or three years' turnover.

Experientia Docet.

LONDON COUNTY COUNCIL.

The Council, on Tuesday, resolved to convene a special meeting to consider the question of making application to the Light Railway Commissioners for powers to construct certain light railways which it is proposed shall be worked by electric traction.

The Conduit Systems.

On the adjourned report of the Highways Committee being brought forward (*vide* the Electrical Review of the 28th ult.), Mr. Parker asked and obtained the permission of the Council to substitute another recommendation to that proposing an expenditure of £180,000 for the purpose of installing the conduit and surface contact systems on the six miles of double line between Westminster Bridge and Tooting. The amended proposal recommended the Council to sanction an outlay of £10,000 for the preparation of plans, specifications and estimates, the Highways Committee intending to submit, at a later date, a scheme for the actual expenditure to be incurred in the carrying out of the work. Mr. Parker, in the absence of the chairman of the committee, formally moved the adoption of the recommendation.

Mr. Gilbert, as an amendment, proposed that the recommendation should be referred back to the Committee. He opposed the expenditure of £10,000, because he thought the Council ought not to expend such a large amount of the ratepayers' money in making experiments. The report of Prof. Kennedy was very meagre, and he considered that it ought to have been brought before the Council in a more detailed form. He did not think that the adoption of the conduit system was the best for London. No tramway company in England would undertake to spend £15,000 per mile of single track, not including the cost of the power station and the cars, and he did not think any provincial Corporation would do so, or that the Council should expend the money. Referring to Prof. Kennedy's report, the speaker drew attention to the statement that it was not necessary to experiment with the overhead system, because the Council had arranged with the London United Tramways Company for that to be introduced in conjunction with the conduit system, and he expressed the opinion that the Council should wait and see the results of those trials. The Highways Committee should have brought up a report on the subject by the manager of the tramways in conjunction with the report of the consulting engineer. Having referred to the conduit systems in Washington, New York, and Buda-Pesth, the speaker challenged the Highways Committee to say whether there was a practical surface contact system in the world. Personally he was not opposed to the overhead system, which was not only much cheaper, but it had been adopted in every town except Birmingham. There was another point to be considered in the sense that the Council was not the road authority along the route of the proposed electric tramways, and he thought they ought to obtain Parliamentary powers for that purpose. In conclusion, the speaker moved that the report should be referred back, in order that the Committee might bring up a detailed report on the subject.

Mr. Piggott, in seconding the amendment, stated that there was not sufficient evidence before the Council to authorise the expenditure of the money proposed by the Committee. With the figures before them that the conduit system would cost four times more than the overhead method, he thought the Council ought to hesitate before agreeing to the expenditure.

Mr. T. B. Westacott suggested that the Committee would be well advised to omit from the recommendation the words "underground systems." He believed the conduit system would be expensive to lay down, but if Mr. Parker would leave the question of traction open, the Committee would have power to instruct Prof. Kennedy to prepare plans and specifications, and then the Council would be able to come to a decision with the full facts before the members.

Colonel Ford considered that the proposal of the Committee was unreasonable, and he expressed the opinion that the Council was indebted to Mr. Gilbert for the information that as long as two years would be occupied in reconstructing the tramways in question.

Lord Welby (chairman of the Council) at this stage called upon the acting chairman to reply.

Mr. Parker, in reply to the discussion, said that he did not consider that Mr. Gilbert had adduced anything to induce the Committee to alter the recommendation. He thought the Council would be better advised to accept the advice of Prof. Kennedy than that of the proposer of the amendment. The Highways Committee were not prejudiced against the overhead trolley system, but they had to consider the local authorities in regard to the matter. The two authorities concerned—the Lambeth Vestry and the Wandsworth Board of Works—would only give their consent to the experiments being made on condition that the Council adopted the conduit system, and the consulting engineer recommended the Council to introduce that method in conjunction with the surface contact system.

On a division the amendment was rejected by 65 to 20 votes.

Colonel Ford, as a further amendment, proposed that Clapham should be substituted for Westminster Bridge, but this was rejected, and a further amendment suggesting the adjournment of the report met with a similar fate. The recommendation of the Committee was then put, with the result that it was carried by a large majority.

Change of Pressure.

The Highways Committee reported that the Westminster Electric Supply Corporation had applied for consent to an alteration of the standard pressure of supply. The company had hitherto used a standard pressure of 100 volts between the middle wire and either of the outer wires, and of 200 volts between the outer wires of the distributing mains, and now desired to increase the standard pressure in the one case to 200, and in other to 400, volts. The company had given notice, by advertisements, of its application to the Council, and the Committee had taken into consideration the letters received from the company's customers in regard to the matter. On the recommendation of the Committee, the Council resolved to consent to the alteration on certain conditions.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week ending Aug 2nd, 1898		Week ending Aug. 1st, 1899.	
Adelaide	Value £4,880	Alexandria	Value £83
Albany	32	Amsterdam	25
Alexandria	47	Antwerp	70
Barcelona	535	Auckland	25
Bombay	39	Bangkok	638
Bolougne	65	Batavia	12
Buenos Ayres	70	Boca	240
Calcutta	141	Bombay	57
Cape Town	33	Boulogne	17
Colombo	88	Buenos Ayres	131
Durban	55	" " Teleg. cable ..	657
East London	53	" " Teleph. fittings	100
Hamburg	70	Calcutta	466
Hankow	10	" Teleg. wire	20
Hobart	400	Cape Town	138
Hong Kong	43	Christiania. Teleg. wire ..	71
Melbourne. Teleg. mat. ..	35	Copenhagen. Teleg. wire ..	116
Naples	60	Durban	22
Oporto	20	Genoa. Teleg. mat.	95
Port Elizabeth	19	Gottenburg. Teleg. mat. ..	21
Rotterdam. Teleg. wire ..	29	Hamburg. Teleg. mat.	21
Singapore	250	Hong Kong	134
Sydney	735	Jersey and Guernsey	1,536
Wellington	387	Key West. Teleg. cable.. ..	46,000
" Teleg. mat. ..	311	Lisbon Teleg. mat	40
" Teleg. mat. ..	2,564	Melbourne	146
Yokohama	103	" Teleg. mat. ..	1,143
		Port Elizabeth	633
		" Teleg. mat. ..	162
		Sarawak Teleph. mat	68
		Shanghai	198
		Singapore	21
		" Teleg. mat.	668
		St. Petersburg	837
		" Teleg. wire ..	380
		Stockholm. Teleg. wire ..	28
		Sydney. Teleg. cable	650
		Teneriffe	80
		Vigo. Teleg. appa.	35
Total ..	£11,119	Total ..	£55,764

Foreign Goods Transhipped.

Telegraph material ..	Value £350	Sydney. Teleph. appa.	Value £45
		Tientsin. Teleg. mat.	188
Total ..	£350	Total ..	£233

Advance in Price.—The Newton Electrical Works Limited, announce that owing to the continuous rise in cost of raw material, they are compelled to increase the prices for all their manufactures 10 per cent. on the net.

Bankruptcy Proceedings.—At the Court of Bankruptcy, at Glasgow, on 7th ult., Messrs. Wilks, Sloan & Co., electrical and consulting engineers, 112, Bath Street, Glasgow, and John Lumsden Sloan, electrical and consulting engineer there, the sole partner of said firm, as such partner, and as an individual came up for examination to be examined in Sheriff Balfour's Chambers, County Buildings, Glasgow.

The *London Gazette* contains notice of the release of trustee in *re* W. R. Riding, electrical engineer, Bournbrook, Birmingham. The date of release was June 5th, the trustee being Mr. L. J. Sharp.

Liquidations, Dissolutions, &c.—Creditors of the Apostoloff Automatic Telephone Parent Syndicate, Limited, are to send particulars of their debts, &c., to the liquidator, Mr. E. Cooper, 14, George Street, Mansion House, E.C., by October 2nd.

A petition for winding up the Madras Electric Tramways Company, presented by the Electric Construction Company, is to be heard before Mr. Justice Wright in the High Court on August 9th.

Berry's Electrical Company, Limited, Birmingham, is winding up voluntarily, Mr. A E. Chatterley, St. Bernard's Road, Olton, Warwickshire, being appointed liquidator.

The Phœnon Electrical Company meeting at Nijmegen, Holland, on July 11th, decided to wind-up voluntarily, and appointed Mr. W. J. Ogden, 6a, Austin Friars, E.C., liquidator.

In the *London Gazette* we observe notice of the release of liquidator in Elmore's French Patent Copper Depositing Company, Limited. The liquidator was Mr. J. H. H. Duncan, and the date of release June 17th.

An account of the winding-up of the Bedford Electric Light Company is to be laid before the shareholders at 3, St. Paul Square, Bedford, on September 1st, by the liquidator (Mr. E. A. C. Rawlings).

Messrs. Wheatley Kirk, Price & Goulty have dissolved partnership so far as concerns Mr. W. R. Goulty. The business will be carried on under the style of Wheatley Kirk, Price & Co., by H. Sherley-Price, and S. and E. A. Sherley-Price, in partnership with John Place, of Altrincham, and they will attend to debts, &c.

Messrs. G. H. Driver, E. W. Fladgate, and J. P. K. Clark (Geo. Driver & Son, electrical and mechanical engineers, Hythe Road, Willesden) have dissolved partnership so far as concerns E. W. Fladgate. Debts, &c, will be attended to by the two other partners, who continue the business under the old style.

Breaking Insulators.—Three boys have been remanded to the workhouse for a week for wilfully breaking telegraph insulators, the property of the Metropolitan District Railway Company, at Acton. It seems a pity that the magistrate could not, as requested, order the boys a good flogging, if only as a preventative for the future.

Colliery Lighting.—Messrs. John Worthington & Co., of Hanley, have obtained the contract for a complete plant for the electric lighting of the Woolley collieries, near Barnsley.

Electric Lighting (Clauses) Bill.—In the House of Commons on 28th ult., the Earl of Dudley, in moving the second reading of this Bill, said that at the present time 60 or 70 provisional orders were granted every year under the Electric Lighting Acts, and in each of these orders there were 80 or 90 clauses, many of which were identical in terms. That entailed a considerable amount of expense to the promoters, and labour to the printers. They therefore proposed to consolidate all those clauses in one Bill, exactly in the same way as in the case of railways, tramways, gas, and other matters. The Earl of Morley agreed that the Bill would have the advantage of saving a great deal of labour, but in dealing with electric lighting orders which had not been put into operation, he suggested that it would be an improvement, instead of saying that the Board of Trade should revoke such orders, that they should lapse within a given time if nothing was done, unless the Board of Trade saw fit to give an extension of the time. The Earl of Dudley said the Board of Trade had already done something in the direction suggested by the noble earl. Last November they communicated with all electric lighting companies who had had orders, and who had not fulfilled their statutory requirements, and warned them that if those requirements were not carried out immediately, the Board would revoke the orders. The effect of that warning had been to bring those companies up to a much higher point of activity, and they proposed to adopt the same course every year. The Bill was then read a second time.

Electric Pumping.—An installation for the electrical pumping of the Arniston Coal Company's mines at Gorebridge, which has lately been introduced, was viewed, on 26th ult., by a large company. The installation is said to be the largest in Britain. The dynamos are driven by two steam engines of horizontal compound long-stroke type, by Messrs. Robey & Co., Limited. Each engine is capable of giving 350 I.H.P. with 120 lbs. pressure, and is fitted with Richardson & Rowland's automatic trip-expansion gear. Each dynamo weighs about 20 tons. The two pits of the Arniston Coal Company are 1,000 yards apart. The shaft of the Emily Mine is 937 feet in depth, and the Gore Pit 678 feet. The parrot seams of the former pit are 308 feet down. The water accumulates at the foot of the main dock road, and to pump this improved mining pumps of the three-throw type, by Messrs. Scott & Mountain, Limited, Newcastle, are fitted up.

King v. Turner.—At the Liverpool Assizes last week in the Nisi Prius Court, before Mr. Justice Bigham and a special jury, Messrs. King, Limited, ventilating engineers, Liverpool, sought to recover damages from Messrs. John Turner & Sons, manufacturing engineers, of Denton, for breach of contract. Mr. Horridge appeared for the plaintiffs, and Mr. Neill was for the defendants. The case for the plaintiffs was that Messrs. King had ordered from the defendants for erection at Messrs. Lever's Sunlight Soap Works, seven electrical motors and automatic resistance frames, to be used in connection with ventilating machinery. The arrangement between the parties had been that the motors should be workable at a voltage of 300, but after they had been supplied to the plaintiffs, and fixed by a practical electrician at Messrs. Lever's, the latter complained that they did not work satisfactorily at all. Plaintiffs communicated several times with the defendants, but although the latter, after considerable delay, sent down some of their own workmen to adjust matters, the motors remained defective. The plaintiffs' manager, Mr. Lees, stated in evidence that, including the profit which they had lost by not being able to fulfil the contract with Messrs. Lever, they were entitled to £237. From this there would have to be deducted the value of the motors, which were at present no more valuable than scrap-iron, worth about £10. The plaintiffs had paid the defendants £140 for the motors. Other evidence for the plaintiffs ascribed the failure of the motors to the fact that the wires of the armature were too slight, and were, consequently, unable to carry off the heat, which became in time excessive. Mr. Neill, for the defence, contended, according to the *Liverpool Post*, that the machines had been made of the best workmanship, according to the plaintiffs' drawings. The machines were accepted by the plaintiffs, and there the defendants' responsibility ended. The cause of their falling off was that they had been neglected by Messrs. Lever's workmen.—Evidence to this effect was given, the witness agreeing that the wires of the armature were sufficiently thick for the work they had to do. The defendants' workmen ascribed the burning of the wires to the use of an excessive current.—His Lordship said the question for the jury was whether the motors were made in accordance with the contract. —The jury found for the plaintiffs, £50 damages.—Mr. Horridge asked for costs on the higher scale.—His Lordship assented, and said it was a proper case to be brought into that Court.

Leather Belting.—At the invitation of the directors of the Woven Leather Machine Belting Company, Limited, Birkenhead, a considerable number of friends and others interested inspected the works, and were shown the various processes, from the treatment of the raw hide to the finished belt. The company have a secret process by which the hide retains its flexibility, and by which the tanning process is considerably shortened. The raw hides, after being stripped and scraped, are placed in revolving vats, in which they remain for two days. They are then transferred to similar vats, in which they remain for a further 48 hours. The hides are then partly dried and split, after which they are cut into strips by hand, the average length of continuous strip from each hide being about 2,500 feet. The strip, which is still damp and very flexible, is wound on spools and shuttles and passes through the looms, after which the belting undergoes the final tanning process, occupying 12 hours. The belt is then stretched by power until all the elongation is taken out, and it is then ready for use. At the luncheon which followed the inspection of the works the chairman, in proposing the toast of the guests, made some remarks on the belting, for which he claimed special suitability for dynamo driving and for machinery when small pulleys were used, owing to its extreme flexibility and elasticity. We had an opportunity of seeing the belt running in the ordinary work of the factory, and also driving the lighting dynamo, and, so far as we could see, the chairman's claims were justified, as the running under full load was extremely smooth, and the belt being spliced showed no jerking or irregularity in the drive. The company will make a speciality of belting for dynamo driving.

Municipal Trading.—From the Liberty and Property Defence League we have received a booklet containing reprints of speeches by the Earl of Wemyss, the Attorney-General, and others, on the dangers of municipal trading.

New Book.—At the end of the month Messrs. Whittaker and Co. will publish a new work, by Mr. W. Perren Maycock, entitled "Electric Wiring, Fitting, Switches, and Lamps." The book will comprise some 446 pages and 360 illustrations.

Oil Filters.—Messrs. Shelby & Co., of Finsbury Circus Buildings, E.C., have supplied the "Warden" oil filter recently to the following houses:—Messrs. Harmsworth Brothers, London (third order); Railway Lighting, Limited, Manchester, for the Great Central Railway's electric power stations (second order); the Corporation of King's Lynn; The Patent Nut and Bolt Company, Birmingham, &c.

Picnic.—The employés of Messrs. Ward & Goldstone, of Manchester, held their picnic on Saturday, July 29th, the day being spent at Morecambe.

Pressing the Button.—The electrical arrangements by means of which H.M. the Queen was last Friday enabled to open the children's wing of the Isle of Wight Infirmary at Ryde by pressing a button were supplied by Mr. F. J. Coleby, of Manchester Square, W.

Stealing Electricity.—On 27th ult. the Recorder's jury found Luigi Armanni guilty of stealing a quantity of electricity belonging to the Metropolitan Electric Supply Company, Limited. The facts of the case have been already recorded in the Electrical Review. Sentence was postponed.

Threatening Prof. Dewar.—Chas. Bomberger who, as already mentioned in these columns, was charged with sending threatening letters to Prof. Dewar, has been discharged and sent to the workhouse as a lunatic.

Weatherley v. The Cornish Hotels.—In the Chancery Division, on 28th ult., this case came again before Mr Justice Kekewich.—Mr. Warrington, Q.C., for the plaintiff, reminded his Lordship that the action was to restrain a nuisance by noise and smell, arising from the working of the engine which supplied the hotel with electric light. Since the investigation and report made by Mr. Ashdown, and referred to on the last occasion, that gentleman had made a further report, he having, as the result of an invitation by the solicitors of both parties, again visited Newquay. The plans suggested for the remedying of the defect had been carried out, and he was given to understand that under the modified conditions plaintiff would have no further ground for complaint. After discussion as to costs, it was decided that the motion be treated as the trial of the action.

Westminster Arc Lamps.—We hear that the Electric Traction Company have placed an order with the Westminster Engineering Company, Limited, for 200 of their "Westminster" long burning arc lamps for lighting the stations, tunnels, yards, &c., of the Central London Railway. They are to burn five in series, and to be fitted with automatic cut-outs and substitutional resistances. We understand that before the order was placed, these lamps, and several other makes in competition, were subjected to a long and careful test extending over some months.

Workmen's Compensation.—Last Saturday Mrs. Merroe claimed compensation for the death of her stepson who was accidentally killed on the first day he entered the employment of the Dublin United Tramways Company as a traverser at the Ballsbridge Power Station. The Recorder at the Dublin City Sessions said that at present he had before him six cases in which the persons were employed for less than a week. The Act of Parliament forced him to give a higher compensation to a man employed for a fortnight than to a man employed for a year, unless the latter worked every day of the year. His award was that the case came within the section of the statute, and he awarded the plaintiff as a partial defendant, as defined by the new statute and Lord Campbell's Act, one-third of the minimum compensation, namely, £50 with seven guineas costs.

ELECTRIC LIGHTING NOTES.

Aberdeen.—At a meeting of the Gas and Electric Lighting Committee of the Town Council on July 28th, the City Chamberlain submitted a statement as to the revenue and expenditure on the electric lighting account for the six months ending June 30th, showing an income of £4,447 and an expenditure of £4,524, giving a deficit of £77. It was agreed that the charge for electric lighting during the next six months should remain the same as at present.

Acton.—The Council has instructed Messrs. Lacey, Clirehugh & Sillar to prepare at once the necessary plans and specifications for the electric light and power plants in connection with the scheme drawn out by them last year.

Belfast.—On July 28th Mr. P. C. Cowan, M.I.C.E., held an inquiry on behalf of the Local Government Board into the application of the County Council for sanction to a loan of £75,000 for electric lighting purposes.

Blackburn.—The Local Government Board inquiry for the borrowing of £25,000 to carry out the scheme of lighting and traction extensions prepared by Messrs. Lacey, Clirehugh & Sillar was held at Blackburn, on Tuesday, August 1st.

Blaenau Festiniog.—The District Council has decided to appoint an electrical engineer to report on the question of electricity supply in the town.

Barnsley.—The Park and Lighting Committee recommends that application be made to the Local Government Board for sanction to borrow £3,000, the estimated cost of proposed extensions at the electric light station. The tender of Messrs. Johnson and Phillips for supplying additional electric plant for £2,236 has been accepted.

The Light Railways Commissioners held a public inquiry on the 2nd inst., into the application of the British Electric Traction Company, Limited, for an order authorising the construction of a light railway in Barnsley and district.

Bath.—Mr. R. Hammond has reported to the Electric Light Committee that the now familiar "noisy" arc lamps are quite satisfactory.

Battersea.—The Vestry, on July 26th, decided to oppose the application of the County of London and Brush Provincial Electric Lighting Company for a provisional order for the parish. In a report by the Law Committee, it was stated that the latter company had again opened Boundaries Road without the permission of the Vestry. The Committee observed that the injunction obtained in the Chancery Divison, which was confirmed by the Court of Appeal, restrained the company from laying any further mains in the parish. The committee recommended, and it was decided, that they be authorised to take such proceedings against the company in regard to the matter as might be considered necessary.

Bridgend.—The English Industrials Company has come to an agreement with the District Council to supply electricity for public lighting at the rate of 2d. per unit, and for general use at 6d. for the first hour, with 3d. for every additional hour.

Byfleet.—The Parish Council has approved of the application of the Cobham Gas Company, for powers to supply Byfleet with electric light and power.

Camberwell.—The General Purposes Committee having received notice from the County of London and Brush Provincial Electric Lighting Company that within 48 hours from date of notice it intended to commence supply in certain specified streets at a pressure of 205 volts, recommended that the company be informed that unless it agrees to carry out the conditions contained in the purchase clause of its order in a reasonable manner, the Vestry intends to make an application for its own order. A letter was received from the company stating that before it can consider the request for certain information, and for an undertaking as to new works it would be glad to know (1) whether the Vestry has passed a resolution in accordance with Section 60 of the Camberwell order, and (2), if so, whether the Vestry intends to require the company to sell the Camberwell undertaking as provided by that order.

Cobham.—The Parish Council has received from the Epsom District Council a letter addressed to the latter on behalf of the Cobham Gas Company, which states the intention of the company to apply for a provisional order to supply electricity in the district. The Cobham Council requested the Epsom Council to oppose the application to the utmost.

Cowes (I.O.W.).—The *London Gazette* contains formal notice of the intention of the District Council to transfer the electric lighting order to the Ventnor Electric Light and Power Company, Limited.

Dudley.—The Electric Lighting Committee of the Corporation have issued a report recommending the Council to accept the following tenders, amounting to £21,472, for permanent work and plant for electric lighting and power station:—Messrs. Babcock and Wilcox, £2,017, for boilers, &c.; the Westinghouse Company, £6,169, for machinery, &c.; Callender's Cable and Construction Company, £7,146, for cables and street work; Messrs. Johnson & Phillips, £423, for street lighting; Messrs. Whittaker & Co., £5,466 18s. 3d., for building stack and engine beds, and £250 for travelling crane (estimate). The committee also recommend that application be forthwith made to the Local Government Board for their sanction to the borrowing, by the Council, of a loan of a further sum of £33,000, on account of the expenses to be incurred in the construction of the generatin station, electric lighting and work connected therewith, to be repaid, together with interest thereon, within a period of 30 years, such amount being made up as follows:—Amount brought down, £21,472 13s. 2d.; meters and house connections, £2,000; steam piping, pumps, heaters, £3,000; railway siding, £500; contingencies, engineering expenses, &c., £6,027 6s. 10d. The Council have already had applications by prospective consumers for the electric light.

East Grinstead.—The Sanitary Committee has received notice that application is to be made to the Board of Trade in December next for a provisional order authorising Mr. L. Dennis and Mr. F. Verrall to supply electricity for lighting and other purposes throughout the parishes of Rotherfield, Buxted, and Withyham.

Godstone.—The District Council has received a communication from Edmundson's Electricity Corporation, Limited, giving formal statutory notice on behalf of the Urban Electric Supply Company, Limited, of intention to apply to the Board of Trade for a provisional order for electric lighting in the parish of Warlingham.

Harwich.—In the *London Gazette* the usual formal notice appears of the transfer of the provisional order to English Industrials, Limited, by the Corporation.

Kettering.—The District Council has resolved to engage Prof. Kennedy to report on the question of proceeding with its electric lighting order, at a fee of 100 guineas.

King's Lynn.—The Corporation having made application to the Local Government Board for sanction to borrow an additional £2,500 for the purpose of extending the electric light in the borough, Colonel W. R. Slacke, R.E., conducted an inquiry into the matter on July 26th. It was explained that the Corporation wished to light by electricity all the streets now lighted by gas, and to extend the mains to South Lynn railway station, which is now lighted by oil lamps. Although the current had not yet been turned on, applications to the extent of 3,500 8 C.P. lamps had been applied for, in addition to the Corporate buildings and the theatre, which result was considered highly satisfactory.

Liverpool.—The city electrical engineer, Mr. A. B. Holmes, has drawn up a lengthy report regarding the system of supply of electrical energy in the city. The report states that electrical energy is supplied in Liverpool by direct current at a pressure not exceeding 500 volts. An area of supply not more than 4 miles in diameter, and requiring not less than 10,000 H.P. is dealt with under the most favourable conditions as regards economy, if supplied from a single station placed in the centre of the area, the electrical energy being generated and distributed at 500 volts pressure. In dealing with larger areas, it is necessary to adopt either a high tension system of supply for the more distant districts, or to increase the number of generating stations. The latter course has advantages as regards simplicity and consequent economy of working, and also as regards safety, as it would be imprudent to depend on a single station for the whole supply of electrical energy for a large city. The greater portion of Liverpool lies within a radius of 2 miles from Pumpfields and Lister Drive respectively, which sites have been selected for the two main electric power stations, as affording cheap delivery of fuel by rail at Lister Drive, and by canal at Pumpfields, the canal at Pumpfields also affording a supply of water for condensing. The demand for electrical energy for lighting is at a maximum only for three or four weeks in mid-winter, and the horse-power of plant required at that period very largely exceeds that which would suffice for the other portions of the year. The Highfield Street, Paradise Street, and Oldham Place stations are very favourably situated and equipped for dealing with the excess winter demand, which is chiefly required for the area included within a radius of 1 mile from the common centre of these three stations. The adoption in Liverpool of a direct current system at 500 volts pressure enables the same plant to be used both for lighting and for tramways. The maximum constant working load of the plant in the stations, when completed, will be as follows: Pumpfields, 15,000 H.P.; Lister Drive, 15,000 H.P.; Highfield Street, Oldham Place, and Paradise Street combined, 9,000 H.P.; Lark Lane and Smithdown Road, 1,200 H.P.; Cobb's Quarry, 600 H.P.—40,800 H.P. To meet the present demand for lighting requires plant of about 10,000 H.P., and with the rapid rate of increase of the last few years, it seems probable that the demand for lighting, together with the demand for mechanical power, which is only commencing, may before long reach 20,000 to 25,000 H.P. The tramways, when completed, will probably require not less than 10,000 H.P. Although the requirements of the present time, and of the immediate future, can be dealt with most advantageously at a pressure of 500 volts, it may, at a future date, be desirable to use a high tension system of transmission in dealing with the development of outlying districts, and there will be no difficulty in providing such a supply, when requisite, from the sites already in the possession of the Corporation.

Manchester.—At a meeting of the City Council on Wednesday, Alderman Lloyd Higginbottom in moving the adoption of the minutes of the Electricity Committee, including the accounts for the year which have already appeared in the Electrical Review, moved a reduction in the price of electricity to large consumers for lighting purposes, and also to consumers for motive power. He explained that it had not been found advisable to recommend a reduction to small consumers. The total reduction would mean a difference of £3,500 as compared with £7,000 allowed for in the estimates. The proceeding of the Committee were adopted. It was decided to apply to the Local Government Board for sanction to borrow £22,000, for the outlay in connection with the new cable, &c., stores at Ardwick. This is part of £500,000 which the Council has authorised the Electrical Committee to borrow for the purpose of their undertaking.

Mauritius.—The tender of Messrs. Dawson & Co., of Pancras Lane, E.C., has been accepted by the Municipal Council of Port Louis, Mauritius, they having been granted the concession for the sole right to light the town and suburbs by electricity. Messrs. Dawson & Co. are the owners of the present gasworks, and they have decided to instal the electric light throughout the entire area. They have already received applications from householders for electric lighting equal to 6,000 lamps.

Newark.—The District Council has received from the Electrical Power Distributing Company formal notice of intention to apply for an order to supply electricity within the borough. It was agreed to have the opinion of a competent engineer to report as to the probable cost of obtaining electrical powers.

North Riding.—The County Council has resolved to devote the sum of £4,500 to a scheme of electric lighting for the Asylum.

Oswestry.—An extraordinary general meeting of the Oswestry Electric Lighting and Power Company, Limited, was held on July 24th, for the purpose of considering the following resolution: "That the shareholders of this company hereby confirm the sale of the undertaking to the Corporation of the borough of Oswestry, on terms already agreed to by the directors of the said company, subject to the necessary consent being obtained, and that the directors be and are hereby empowered to take all necessary steps to carry out the same." The chairman having explained the terms of sale, at the price of £11,200, the motion was put to the meeting and carried.

Ross.—Messrs. Harvey, of Purland Chase, Ross, have abandoned their intention of applying for a provisional order for the installation of electric light at Ross. The question of electric lighting now lies solely with the District Council, which is awaiting the report of the electrical engineer.

Wakefield.—The Corporation has decided to apply for leave to borrow £25,000 for the purpose of carrying out extensions.

Wingate.—At a parish meeting held at Wingate on July 25th it was decided to adopt the Lighting Act, and expend a sum not exceeding £400 for the first year's cost. The contract for the erection of 42 lamps and all accessories has been let to Mr. G. H. Armstrong, Chester-le-Street, for £301. The necessary power for lighting will be supplied by the Wingate Coal Company at a cost of £2 per lamp per year.

West Bromwich.—The Electric Lighting Committee of the Town Council have decided to proceed at once to lay down the requisite plant for lighting the town by electricity. The committee have resolved to make application to the Local Government Board for sanction to borrow the sum of £20,000 for the purpose of carrying out the scheme agreed upon. It is proposed at first to supply only the compulsory area for which a provisional order has already been granted, and to extend from time to time when necessary.

Wrexham.—The Town Council has resolved to apply to the Local Government Board for consent to borrow £20,000 for the establishment of an electrical supply works, and for incidental expenses.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Ben Cleuch.—This, the highest mountain in the Ochil range, is about to be made more accessible by an electric railway to its summit. Mr. Hewitt, of Manchester, the engineer to the promoters, has made the final arrangements for the necessary concession, with Mr. Atherton Gray, factor to Miss Johnston, of Alva, the proprietrix of Ben Cleuch, who has given every facility to the promoters, her desire being to benefit the district. It is intended to erect a sanatorium or hotel on the summit should the option obtained to make the railway be taken advantage of. We understand that in all likelihood the construction of the line will be proceeded with without delay should no engineering difficulties of a serious nature present themselves.

Bexhill.—The Light Railway Commissioners have granted the application of Mr. W. M. Murphy for an electric tramway to connect Bexhill with St. Leonards.

Dublin.—It seems that on Sunday evening, a London tourist (named Manners) was travelling on the top of an electric car coming from Clontarf to Dublin, and being desirous of alighting he asked the conductor, who was collecting fares from the outside passengers, to stop the car. The conductor told him to pull the cord of the bell, but Manners, in error, pulled the rope attached to the trolley, which, being thus displaced, struck the span and guard wires, breaking them, and causing the broken ends to fall amongst the passengers on the car. Owing to the contact of those wires with the overhead conductor three passengers received shocks. They remained unconscious in the hospital for three or four hours, and were afterwards suffering from the effects of the shock. At the Dublin Metropolitan Police Court Manners was charged with unlawfully interfering with the wires; the city magistrate, in dismissing the charge, said that the Tramway Company was to blame for not having a man to remain constantly in charge of the trolley ropes!

On Monday night an accident occurred at Gardiner Street. The trolley pole of a double-decker slipped from the wire and became entangled in the span wire, which snapped and fell upon the car and into the street in an electrified state. No one was injured.

Electric Railways.—The Earl of Morley's House of Lords Committee last week ordered to be reported the Charing Cross, Euston, and Hampstead Railway Bill, and the Brompton and Piccadilly Circus Railway Bill.

Gateshead.—At a special meeting of the Town Council on July 26th, the committee recommended that the Council rescind their resolution of June 7th, refusing permission to the Tramways Company to construct a railway from Askew Road *viâ* Pine Street and Team Street to the borough boundary at Dunston, and in view of the company having met the Council upon the points at issue, do now grant permission to construct the line under the Light Railways Act, and subject to the provision as to purchase under the Tramways Bill of the present session of Parliament, and to all other conditions contained in that Bill being made applicable to the said railway. After some discussion the recommendation was agreed to.

Gillingham.—On July 27th Mr. Madgen, a director of the Electrical Power Distribution Company, Limited, interviewed the Council relative to the company's proposed application for a provisional order to supply electrical energy for public or private purposes in the district. It was decided that the matter should be dealt with in committee.—The Chatham and District Light Railways order came into force on July 25th.

Halifax.—The Corporation is about to apply to the Local Government Board for sanction to borrow the sum of £18,842 for electric lighting purposes, and also £49,217 for electric tramways.

Italy.—A contract has just been placed with Messrs. Felix Singer & Co., of Berlin, for the construction of about 30 kilometres of electric tramways in and about the town of Catania.

Liverpool.—At the next meeting of the Liverpool City Council a proposal will be submitted by the Tramway Committee to extend the electric tram system to the whole of the city. The proposal involves the expenditure of close on a quarter of a million sterling. About £120,000 is represented by the cost of the permanent way and the necessary overhead electrical equipment, while £110,000 is put down for the extra cars required. It is proposed to purchase 200 top-seated electric cars at a cost not exceeding £550 each, 50 cars to be delivered in each quarter of the year 1900.

The city electrical engineer has, in compliance with a request of the City Council, reported that the standard top-seated cars weigh, when fully loaded, about 10 tons, the American long cars about 15 tons, and the German car and trailer about 14 tons. The experimental runs that have been made show that the amount of electrical energy used per ton per mile over the same route is, approximately, one-tenth of a unit for the standard four-wheel cars, and about 10 per cent. less for the long American cars, which run with less friction round the curves, being mounted on swivelling trucks. The amount of energy consumed per passenger per mile, when the cars are fully loaded, is about two-hundredths of a unit for the top-seated cars, and nearly three-hundredths of a unit for the long American cars, and also for the German cars and trailers. In the event of the long American cars being fitted with top seats, the consumption of energy per passenger per mile would not exceed that of the four-wheel cars. The insulation resistance of the tramway conductors and feeders is tested every night at the generating station, at a pressure of 500 volts, and up to the present a very much higher insulation resistance has been maintained than the limit prescribed by the Board of Trade. If the insulation could be maintained at the above standard, the cost of the electrical energy lost by leakage would be, for the existing tramways, at the present rate of charge, less than 8d. per annum.

The Metropolitan Railway and Electric Traction.—Addressing the shareholders of the Metropolitan Railway Company last week, Mr. Bell said, as to the important question of electrical traction, the engineer had expressed the hope that the experimental train would be ready in about two months' time. This was certainly good news, and they all looked forward with great hopes to a successful result. But it was only an experiment, and he did not want it to be supposed that in two months' time electrical working would commence to take the place of steam working. That this

result would come about in the future he had not the least doubt, but with the enormous traffic which the Metropolitan had to accommodate and the punctuality which had to be observed the change from steam to electrical traction required the most anxious care and precautions. To change the conditions of working of a railway over which 95 millions of passengers travelled in the year, without interfering with the punctuality and usefulness of the service, was necessarily a serious enterprise.

Mirfield.—The Huddersfield Corporation have agreed to the extension of their proposed electric tram service to Mirfield, provided the District Council supports them in their application to Parliament for powers, and provided the roads are the necessary width.

St. Helens.—The new electricity works, which was recently described in our columns, was formally opened on July 31st. The Town Council has voted a bonus of £100 to Mr. Highfield, the borough electrical engineer, as an expression of its satisfaction with the way in which the work has been carried out by him.

Sheffield.—A Mr. Turton, writing to the *Sheffield Independent*, points out the danger of cars with seats on the top but no roof, in cases where the trolley wire is suspended over the centre of the track. That such danger exists cannot be disputed; a breakage of the trolley wire might have very serious results to those upon whom it fell. (See also under Dublin.)

South Staffordshire.—Mr. Robbins, the general manager of the South Staffordshire Tramways Company, has laid the grievances of the engine drivers with respect to their long hours before the directors of the company, and they have decided that the number of working hours of the drivers and also the guards shall be reduced.

Stoke-on-Trent.—At a meeting of the Corporation on July 27th, a letter was read from the Potteries Electric Traction Company in reply to a communication from the Corporation to the effect that unless the extension to Trent Vale was completed within the time stipulated the Corporation intended to enforce the penalty of £500. The company wrote that they were making every effort to get all the authorised lines constructed as soon as possible, but they had been much handicapped by circumstances over which they had no control. Delay had also been caused in consequence of the improvement proposed by the Corporation at Etruria. They presumed the Corporation desired to have the lines to Trent Vale carried out, and that object was not likely to be furthered by the Corporation adopting the attitude expressed in the town clerk's letter.

TELEGRAPH AND TELEPHONE NOTES.

British North Borneo Telegraphs.—The British North Borneo Company is said to have decided to take over and occupy the Tambunan Country, in the interior of British North Borneo. The company has sent instructions to Sandakan for its officials to construct a road and telegraph line into the heart of Tambunan.

Foreign Telegraph Rates.—It is stated that Sir Edward Sassoon has given notice in the House of Commons that on Tuesday next he will ask the Under Secretary of State for Foreign Affairs whether, in view of the efforts now being made for a reduction of foreign, colonial, and Indian telegraphic charges, Her Majesty's Government will request Her Majesty's Ambassadors at Constantinople and Teheran and Lord Cromer to procure from the Turkish, Persian, and Egyptian Governments respectively copies of all concessions granted to, and all agreements made with, either the Eastern Telegraph Company, the Indo-European, or the Telegraph Construction and Maintenance Company, or the agents of all or any of them, and with the Indian Government.

Glasgow Telephones.—In the House of Commons on Wednesday the order for the second reading of the Glasgow Corporation Telephones Bill was discharged and the Bill withdrawn.

Iron Telegraph Poles for Victoria.—Iron poles are in future to be used for the support of telegraph lines in Victoria. They have been in use for many years in the neighbouring colony of New South Wales, and have been tried in a small way in Victoria with the result that the Postmaster General has decided that they are to be employed generally instead of wooden poles as soon as supplies can be obtained. One of their advantages for colonial use is that they are less liable than wooden poles to be affected by bush fires, besides which they last longer than wood. As iron poles will be used not only in the equipment of new lines, but for the replacing of the present wooden posts as they wear out, they will be in constant demand, and it is intended, if possible, to establish a colonial manufactory for them.

Liverpool-to-Paris Telephone.—The Postmaster-General has informed the Liverpool Chamber of Commerce that negotiations were proceeding with the French Administration of Post and Telegraphs with regard to tariffs and other matters, and adding that no difficulty was apprehended in eventually establishing a telephone communication between Liverpool and Paris.

The Reduction of Rates to India.—We have shown that while telegrams in transit from London to Australia or *vice versâ*, are profitably passed between Bombay and London at the rate of 1s. 3¼d. per word, a telegram from London, passing over exactly the same line, and requiring exactly the same amount of attention, has to be paid for at the rate of 4s. per word, if it is destined for Bombay instead of for some point in Australia. There is evidently something wrong about this, which, doubtless, will be put right in the near future. There is, however, a point of apparently minor importance to which we wish to call the attention of our readers, and which we will try to lay before them as clearly as may be. In giving evidence before the Pacific Cable Committee, the representatives of the Eastern Extension Telegraph Company (among them the Marquess of Tweeddale, who is also chairman of the Eastern Telegraph Company), showed that the Eastern Extension Company, whose lines come no further westward than Madras, were liable to substantial out-payments to the Governments of Australia, Java, and India, but what concerns us most at present is the fact that, as far as the associated companies are concerned, the *only* out-payment that is made on a telegram from Bombay to London is the sum of 2d. per word, while the cost of the same telegram to the public is 4s. per word. This 2d. per word is paid to "Europe" (see reply to question No. 1,787 Blue Book, C—9,247, of 1899), but further on in the evidence we find the following:—Q. 2,007, "And where does the 2d. in Europe go to?—Partly to Great Britain, the Telegraph Department here, the French Government, the German Government and other European Governments; the average is about 2d. per word." The remainder of the evidence, which we printed *in extenso* last week, shows that the company pays the English Post Office an amount "which works out taking the average at 2d." From this last statement it would seem that as the English Post Office gets all of this out-payment of 2d. per word, the payments to "the French Government, the German Government, and other European Governments," resolve themselves into vanishing quantities! Surely such a self-contradictory statement calls for explanation, especially when made by those who so indignantly challenge the accuracy of the grounds for the arguments recently advanced by Sir Edward Sassoon and others on this and kindred subjects.

Telegraph Rates to India.—In a letter to the *Times* Mr. J. Henniker-Heaton says:—"It is gratifying to learn that the Eastern Telegraph Company announce their intention to reduce the telegraph rates to Australia to 4s. a word and to expend an enormous sum in constructing what will be a duplicate line to Australia. May I prophesy that the Eastern and the Indo-European Company will reduce their telegraph rates to India to 2s. per word within the next six months? In a few days I purpose asking for a little space to inquire regarding certain alleged monopolies enjoyed by the Eastern Telegraph Company and its satellites over landlines, which I am certain the Marquis of Tweeddale (whose courtesy I am bound to acknowledge) will reply to when the Royal Commission is appointed."

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa ...	April 4th, 1898 ...	...
Jamaica-Colon	June 30th, 1899 ...	...
Bonny-Cameroun	May 29th, 1899 ...	...
Latakia-Cyprus	June 20th, 1899 ...	...
Para-Maranham	April 10th, 1899 ...	...
Maranham-Ceara	July 25th, 1899 ...	...
Medan-Olehleh	July 31st, 1899 ...	...
Accra-Grand Bassam... ...	August 1st, 1899 ...	...
Landlines.		
Communication between Salonika and Monastir ...	March 23rd, 1899 ...	...
Communication between Bolama-Bissao	July 28th, 1899 ...	...
Landline between Puerto Plata-St. Domingo ...	August 1st, 1899 ...	August 2nd, 1899

Telegraphists' Grievances.—Under the auspices of the Joint Committee of the Postal and Telegraph Associations, a conference of postal and telegraph servants was held on Tuesday at the Westminster Palace Hotel, for the purpose of urging the expediency of the appointment of a Parliamentary Select Committee to inquire into the grievances of those engaged in the postal and telegraph services of the country. Mr. William Davis presided. He said there was now every reason to believe that the postal and telegraph servants would ere long secure from the Secretary to the Treasury what had so long been denied them—the appointment of an independent Parliamentary committee to consider their grievances—and that in the result they would obtain some measure of reform and justice.

The Telephone Bill. Third Reading.—The Telegraphs (Telephonic Communication) Bill passed its third reading in the House of Commons on Monday night. In the course of the debate Sir J. Joicey said the Bill had been entirely changed since it was before them on the second reading. He had strong objection to the Bill on various grounds, and not the least of them was that the Government proposed to treat London differently from other parts of the country. London required very little special assistance. The Government seemed to have given up all idea of competition in the Bill, but all the opposition offered was of no avail in the face of the great majority at the back of the Government. He believed, says the *Times* report, if the supporters of the Government had been left free on this question the Bill would have been of a different type from what it was. The Government had the power to establish telephones in any part of the country, but instead of doing that they discouraged competition. The object probably was that they looked forward to the future when they would obtain the telephones, and that then it would be better to have to deal with only one instead of several

companies. Another of his objections was that he did not want to see municipalities become the suppliers of telephone services. The chief objection, however, to the Bill was that it deferred the nationalisation of the telephones for very many years, if it did not put it out of the question altogether.

He concluded by moving that the Bill be read that day three months.

Mr. Hedderwick who supported the amendment, said the right hon. gentleman the Secretary to the Treasury had produced a Bill which he would not have been responsible for had he been allowed to carry out his own ideas. If the right hon. gentleman had had the courage to purchase the National Telephone Company in the interest of the country he might by means of a sinking fund have obtained for the country by 1911 a national telephone system at practically no cost.

Sir H. Bullard supported the third reading of the Bill. Any further delay would be detrimental to the utility of that useful invention, the telephone.

Mr. Pirie opposed the Bill, which he said was an example of the manner in which the Government placed private, sectional, and company interests before the benefit of the general community. The duty of the nation was to strain every nerve to maintain, if not to increase, our commercial lead, and to this end the development of such a valuable commercial instrument as the telephone was very necessary. It seemed to him, however, that this Bill was more likely to perpetuate our inferiority. It was an unworkable Bill, and he did not believe that an assembly of poor men would have passed a Bill so crooked.

Sir C. Cameron supported the Bill, and congratulated the Secretary to the Treasury on having secured a number of advantages in the course of the negotiations with the company. In its present shape the Bill was a vast improvement on the measure originally introduced, and he hoped that steps would soon be taken to establish a system of rural telephones throughout the country.

Mr. Lawrence said his constituents were of opinion that the introduction of this Bill had been a mistake, and he protested against its passing. It was evident from the terms of the Bill that it was only one step in the direction of the nationalisation of the telephone. London was to enjoy this nationalisation without delay, and what London would receive to-day the provinces would receive to-morrow. The country districts would not rest content till the facilities which were given to London were extended to them. In the interests of the State and the taxpayers it would be well if the Treasury were to buy up the existing telephone system while it was still in its infancy instead of postponing the time for 20 years, when they would have to pay 100 per cent. more than the present value. As, however, the Bill gave to London what it denied to Liverpool he could not give it his support.

Mr. Cawley, as a Liberal member, supported the Bill, because he believed it carried out the recommendations of the Select Committee that general, immediate, and effective competition was desirable and should be set up. The Bill was an honest endeavour to give a cheap and effective telephonic system, and he believed it would give to constituencies such as his own, containing many small shopkeepers and traders, the inestimable benefits of the telephone at a moderate price.

The House then divided, and the numbers were—

For the third reading	132
Against	29
Majority for	—103

The Bill was then read a third time.

Wireless Telegraphy.—We read in an American newspaper that Marconi's system is to be put in operation in Hawaii as a means of communication between the different islands of the group. An organisation has been formed, capital is subscribed for the project and some material for the system is already on the way. There is only one channel between islands in the group that is wider than the English Channel. That is the one between Oahu and Kauai, and to the minds of the promoters of the enterprise, communication across this is the only part of their plan which is problematical. It is stated that in connection with the forthcoming Health Congress at Blackpool it is proposed to utilise the summit of the Blackpool Tower for transmitting messages by Marconi's system to Manchester, Liverpool, Glasgow, Oldham, the Isle of Man and London. The Wembley Tower is to be used as the London station.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barking.—August 12th. The District Council wants offers for the free wiring of premises within the area of supply. See "Official Notices" July 28th.

Battersea.—August 31st. The Vestry wants tenders for an overhead travelling crane (hand or electric), and batteries for the electricity works. See "Official Notices" July 7th.

Battersea.—August 31st. The Vestry wants tenders for steam pipes, pumps, condensers, economiser, tools, &c., also switchboard and booster. Specifications at the office of Prof. Kennedy, 17, Victoria Street, S.W.

Birkdale.—August 19th. The Urban District Council invites tenders for the transfer of its electric lighting powers.

Blackpool.—August 21st. The Corporation wants tenders for 10 double bogie tramcars. See "Official Notices" July 28th.

Bridgewater.—August 4th. The Bridgewater trustees want tenders for conduits and wiring for 500 lights in Bridgewater House, St. James's Park, S.W. See "Official Notices" July 28th.

Carlisle.—August 17th. The Corporation wants tenders for boilers, engines, dynamos, and condensing plant. See "Official Notices" July 28th.

Darwen.—August 22nd. The Corporation wants tenders for rail bonds. See "Official Notices" this week.

Dundee.—August 23rd. The Council wants tenders for the overhead line equipment and rail bonding of the Perth Road and Lochee tram routes. See "Official Notices" this week.

East Ham.—September 9th. The Urban District Council wants tenders for combined electric light and traction plant, engines, generators, overhead line equipment, cars, switchboard, arc lamps, &c., water-tube boilers, condensers, and other steam plant, electric light cable. Mr. W. C. Ullmann, The Limes, White Post Lane, East Ham, is the Council's electrical engineer. See "Official Notices" this week.

Germany.—Tenders are at present being invited by the Frankfort-am-Main Municipal Tramways Committee for the supply of 200 steel tyres and 40 sets of wheels and axles for electric tramcars. Tenders to be sent to the Betriebs Direction der Städtischen Strassenbahn, Frankfort-am-Main (Bockenheim), whence particulars may be obtained.

Glasgow.—August 21st. The Corporation wants tenders for the supply of switchboards, copper bus bars, and electricity meters. See "Official Notices" this week.

Ingleton.—The Ingleton Electric Light and Power Company wants tenders for the supply of dynamos, switchboards, batteries, and wiring. See "Official Notices" this week.

Malmo.—September 1st. The Gas Works' directors want tenders for the erection of electricity works for the city. Particulars on application to the clerk of the Gas Works (deposit 12s).

Motherwell, N.B.—August 18th. The Commissioners invite tenders for machinery and works in connection with the proposed electric lighting of their town. See "Official Notices," July 28th.

Perth.—August 28th. The Commissioners want tenders for boilers, condensers, steam dynamos, switchboard, underground mains, and accessories. See "Official Notices" July 28th.

Portugal.—September 6th. Tenders are being invited by the municipal authorities of Cascaes, Portugal, for the concession for the electric lighting of the town.

St. Mary, Battersea.—August 31st. The Vestry wants tenders for steam pumps, pipes, condenser, economiser, &c, switchboard, and boosters. See "Official Notices" July 28th.

Salford.—August 8th. The Corporation wants tenders for eight 750-kw. continuous current steam dynamos for electric lighting and traction. See "Official Notices" July 7th.

Sydney (N.S.W.).—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

The War Office.—The Secretary of State for War announces that tenders for various articles, including electrical instruments, will probably be invited from time to time during the next 12 months. Manufacturers who may wish to be applied to when tenders are required, should address Mr. A. Major, Director of Army Contracts, War Office, stating the particular articles they manufacture, and the names of at least two well-known firms or public bodies who have purchased from them, and are in a position to certify as to the quality of their productions.

Withington.—August 8th. The Urban District Council wants tenders from electrical engineers who would be prepared to enter into contracts for wiring and fitting the Town Hall for electric lighting. Particulars from the surveyor, Mr. A. H. Mountain, Town Hall.

CLOSED.

Barton (Manchester).—The Board of Guardians, on Wednesday, accepted the tender of Messrs. S. H. Heywood, Manchester, for the supply of the electrical plant, dynamo, and engine for the new Union hospital at Patricroft. The estimated cost of the work is £1,278 10s. There were 32 tenders, independent of seven for the requisite fittings, the consideration of which was referred to the Building Committee.

Blackheath.—The British Electric Installation Company, of Soho Square, has secured the contract for lighting the Arts Club and Conservatoire of Music, at Blackheath.

Doncaster.—The Guardians have accepted the tender of the Keighley Electric Lighting Company for lighting the new workhouse electrically, at £2,700.

London.—The London County Council on Tuesday considered the undernoted tenders for wiring the Holborn fire station:—

F. A. Glover & Co.	£264
Drake & Gorham	349
Russell & Russell	397

As the lowest tender exceeded the estimate of £200 suggested by the Chief Engineer, the Council decided not to accept any of the tenders but to cause the work to be carried out by the direct employment of labour under the supervision of the Chief Engineer.

The Council received the following tenders for the erection of the proposed generating station to be built on the Victoria Embankment:—

Holloway Bros. (accepted)	£10,950
F. & H. J. Higgs	11,614
J. Shillitoe	11,790
B. Nightingale	13,573

Spain.—La Société La Metallurgique, of Brussels, has secured a contract for 80 electric tramcars for Madrid.

Sunderland.—It is stated that the Corporation, on Wednesday, gave a contract to Messrs. Dick, Kerr & Co., at £126,000, in connection with the electric trolley equipment of the tramways.

Wolverhampton. — The Town Council, on Tuesday, accepted the amended tender of the District Electric Company (£69), for the electric fittings at the new swimming bath.

FORTHCOMING EVENT.

Saturday, August 5th.—2 p.m. Annual general meeting of the North of England Institute of Mining and Mechanical Engineers, at the Wood Memorial Hall, Newcastle-on-Tyne.

NOTES.

Wireless Warfare.—The daily papers are full of sensational descriptions of experiments with wireless telegraphy by Mr. Maskelyne at Newbury. Magazines have been exploded at 400 yards from the sending station, and could, according to Mr. Maskelyne, be exploded with equal ease 10 miles away. The imagination of the reporter sees in this a revolution in warfare. French powder magazines, in dangerous proximity to our shores, could, of course, be exploded from the North Foreland lighthouse. The *Pall Mall Gazette*, which is usually accurate in its science, recognises that somebody will have to plant the receiver and the detonator in the magazine, but our contemporary does not appear to realise that this is merely a variation of the traditional method of catching a bird by putting salt on its tail. The *Daily News*, in discussing a rival system by Mr. John Munro, says:—"With these, and other inventions, such as the Tesla torpedo, in prospect, it would seem that electricity is destined to revolutionise the art of war. Mr. Maskelyne has proved, if proof were needed, that ether waves can blow up a powder magazine at a distance of miles. Is there anything to hinder guns from being fired from a distance? Surely not. It is possible, therefore, that batteries or maxims may in future be worked and fired from a safe cover, and this improvement is the more likely in that smokeless powder enables the sharpshooters of the enemy to pick off artillerymen working guns at a distance of a mile or more." If one belligerent can work its artillery and maxims from a safe distance by wireless telegraphy, so can the other. We may expect, therefore, that battles in the future will be carried on by the unmanned artillery, while the armies retire a few miles to the rear to lunch. We understand that the apparatus used at Newbury was supplied by Messrs. A. Rosenberg & Co., of Southampton Row, W.C.

The Westinghouse Gas Engine.—Referring to our description of this engine in last week's issue, a correspondent has reminded us that the Dawson gas engine was specially made for direct coupling to dynamos, and we illustrated this on page 225 of the ELECTRICAL REVIEW for February 18th, 1898. There are also, he says, two or three gas engines on the English market that do not govern on the "hit-and-miss" principle, the Wells motor amongst others.

Röntgen Society.—We have received a copy of the report of the Council of the Röntgen Society, for the year ended July 1st, 1899, together with the rules and list of members. Dr. F. H. Low is nominated for election as honorary secretary, Dr. Walsh having resigned. Mr. Wilson Noble has been nominated as president for the ensuing year.

The Institution Visit to Switzerland.—We have received a detailed programme of the visits arranged for in connection with the reunion of the Institution of Electrical Engineers in Switzerland from September 1st to 9th. We understand that this has been sent round to the members of all classes of the Institution resident in Europe. We extract a note of some of the arrangements:—

On Saturday, September 2nd, there will be a visit to the Rheinfelden power station (low speed turbines, three-phase and continuous current generators) and lunch at Rheinfelden. In the afternoon the party will proceed to Baden and visit the works of Messrs. Brown, Boveri & Co., for the construction of electric generators, motors, transformers, &c.

On Monday, September 4th, the works of the Maschinen Fabrik Oerlikon, for the construction of electric generators, motors, transformers, electro-mechanical appliances, machine tools, &c., will be visited, and the Dowson Gas Generating Station of the Zürich-Oerlikon Street Railway, to be followed by a visit to Messrs. Escher, Wyss & Co.'s works for the construction of turbines, pumps, steam engines, refrigerating machinery, steamboats, boilers, &c.; also to the steam and water-driven municipal central station of Zürich, generating single-phase, three-phase, and continuous current; and, the municipal sub-station, for transforming three-phase into continuous current for street railway service. For those who prefer instead of some of these visits, to see the engine and boiler, &c., works of Messrs. Sulzer Bros., and the works of the Locomotiv Fabrik at Winterthur, arrangements have been made.

On Tuesday, September 5th, in the morning and afternoon, there will be visits to the old station for the transmission of power by wire rope, and to the new electrical power station (supplying single and three-phase current) at Schaffhausen, and to the Falls of the Rhine; or to the iron and steel (including electric welding) works of Messrs. Georg Fischer; or a visit to the National Museum at Zürich, under the personal guidance of the director of the museum, Mr. H. Angst (who is also the British Consul-General); and visits to the telephone exchange, postal telegraph department, post office, and new gas works. In the evening there will be a banquet offered by the Swiss firms and the Schweizerischer Elektrotechnischer Verein to members and ladies accompanying them.

On Wednesday, September 6th, there will be a meeting in the Polytechnikum, lunch to the Swiss hosts, visit to the Polytechnikum, and departure for Lucerne.

On Thursday, September 7th, there will be visits to either the Stanstad-Engelberg Railway (three-phase metre-gauge railway, 14 miles long), or to Interlaken *vid* the Brünig Pass. The Rathhausen central station (a two-phase, low speed, turbine-driven plant for lighting and power) and the Lucerne tramways may be inspected by members before starting for Interlaken. Rathhausen is about four miles from Lucerne, and can be reached by carriage.

On Friday, September 8th, there will be a visit to the Jungfrau (three-phase rack) Railway, and three-phase turbine-driven generators in power station, *vid* Lauterbrunnen and the Wengern Alp Railway; lunch at the Scheidegg; return to Interlaken. The power station at Lauterbrunnen may be inspected.

On Saturday, September 9th, arrangements have been made for a visit to the Kander Werk at Spiez (central station for power distribution, lighting, and for the Burgdorf-Thun Railway; power transmitted at 16,000 volts); and to the Burgdorf-Thun Railway (three-phase railway, 25 miles long, with through passenger traffic from ordinary railway lines).

The Labour Clause Question.—We congratulate the Sheffield Electric Lighting Committee upon taking an independent line in placing one of its electrical contracts. We wish that other municipal committees would cease to impose their unfair and interfering labour clauses. We sincerely hope that the Sheffield Committee will have force of character to treat the following bit of bluff as it deserves:—

The Sheffield Branch of the Steam Engine Makers' Society last week passed the following at a special meeting:—"That this meeting of engineers hereby regrets that there appears to be a disposition on the part of the Electric Light Committee to let contracts to a firm which is well known not to pay trade union wages, nor to observe proper conditions of work, and urges them to reconsider their decision."

The *Pall Mall Gazette* prints the following letter, headed "Unfair Conditions," from "P.":—

In connection with certain contracts lately advertised, some of the London District Councils, notably Poplar and Hackney, have decided that the orders shall be placed—in one case at an advanced price—only with firms employing members of certain societies—thus giving an undue preference to their own friends. Should not the Local Government Board take steps to prevent this by refusing powers to obtain loans to such councils as act in this protectionist spirit?

In connection with their electric lighting scheme the Council of Battersea, apparently, has decided to take the same course, with the result that if such action is allowed, every skilled labourer will ultimately be forced to join some union—either the local society or the workhouse.

The Renewable Lamp Company.—A correspondent writes too late for our "Correspondence" columns:—"I have not seen the actual lamp, but having read all the patents relating to lamp manufacture, I am fairly acquainted with its details. There have been a large number of patents for renewable lamps, and I have manufactured and tested a good many such lamps; up to the present I do not know of any one which is successful. The reasons for this are that the raw materials of such a lamp are now so cheap, whereas the labour is dear. The ordinary lamp is so arranged that a minimum of skilled labour is required, whereas with such a renewable lamp, greater skill and care are required to prevent an undue amount of breakage and faults. For instance, the bulb for such a lamp will be dearer to start with, and its initial working up into a lamp will be dearer; when this lamp requires a new filament, the extra cost of a skilled glassblower, and the cleaning of the bulb, will exceed that of a new ordinary lamp bulb; then, again, the labour on the latter bulb, to make it into a new lamp, will be less than that required to even close up the neck of the renewable lamp, and the breakage in each case will be far greater with the renewable lamp. Thus the renewable lamp starts by being more costly in its first stages, and it has no chance of gaining ground in the succeeding operations. I may say that the filament in an ordinary good class lamp is dearer than the bulb, and is worth a good deal more than the 'brass socket and nickel wires' all lumped together. As I have given you the comparison (above) as to platinum and bulb saving, it is impossible to see where these renewable lamps 'will be of great value in reducing the cost of electric lighting.'

"The difference between old and new platinum amounts to almost nothing, the cost of making the nickel or platinum supports is also a small fraction of a penny. The subsequent operations of pumping and testing may be the same for both kinds of lamp and the special cap which is used over again has the same fatal drawback as the bulb—*i.e.*, increased expert labour and liability to increased breakage. Altogether, I think a renewable lamp cannot now be made on a successful commercial basis owing to the low selling price of an ordinary new lamp, which will, from every standpoint, be a better and more durable article. I note that it is only possible to renew their own pattern of long-neck bulb.

"Please excuse the length of this letter, and its practical particulars; it is difficult to otherwise give you some of the chief difficulties which such lamps present to an actual manufacturer. To the public a 'renewable lamp' is a very catching title."

A Hole in the Corner!—Surely the end of the copper combine cannot be far off! We read in the *Standard* that a vessel has taken to New York 250 tons of Indian copper coins, imported as scrap, they being at present more valuable thus than as money! It is added that China and India are both in danger of losing their circulating medium in this way! The Copper Trust has much to answer for, but, there, we are not told to whom these copper coins were consigned. Perhaps they are to be held in Trust until the crash comes! May we suggest a wholesale collection of copper kettles and domestic etceteras? Let us take heart from the fable of the lion and the mouse.

Appointments Vacant.—The following advertisement appeared in the *Times* the other day:—

> **Wanted, manager for company interested in tramway development in England. Must have knowledge of electricity and gas traction, and be used to negotiations with local authorities. Liberal salary and participation to active and competent man. Apply to X Y.Z., care of Messrs. Street & Co., 30, Cornhill, London, E.C.**

An electrical engineering draughtsman and designer, and a physical lecture demonstrator, are wanted for the Northampton Institute, Clerkenwell. See "Official Notices" this week.

Electrocution.—On July 31st, two murderers were electrocuted at Sing Sing Prison. It is stated in a London daily that five successive applications of the current were necessary before one of the men could be pronounced dead.

Electrical Resistance Company.—The following letter, dated August 2nd, from Mr. James Swinburne arrived too late for our "Correspondence" columns:—"In your last issue you published an unsigned article dealing with the prospectus of the Electric Resistance Company and of the patents acquired by it, and you say, 'What a pity the directors did not look through the files of the ELECTRICAL REVIEW.' If that article be a specimen of these files, it would be most unprofitable to do so. The author of the article is either very careless or very unscrupulous. If he has read the patents to which he refers, his aim must have been to mislead the public. If he has not read them, his writing in such terms is an act which needs no comment. It only remains for me to add that Nussbaum's specification was before counsel, and that anyone acquainted with patent law will see on examining it that it does not anticipate the claims of the company's patents. The names of the counsel who pronounced upon this question are a sufficient guarantee for this."

[It is hardly necessary to tell Mr. Swinburne that the Editors of this journal take the responsibility of unsigned articles, and it seems to us that our reference to the files of the REVIEW was perfectly clear to everybody except our esteemed correspondent, as we quoted the very patent which we thought it might have been desirable for the directors to have seen. Our aim is ever to guide, not mislead, the public, and the sole patent to which we referred was that of Nussbaum, the greater part of which we published. We fully admit Mr. Swinburne's exceptional knowledge of patent law, but we simply made a comparison between his report to the company and Nussbaum's specification, and again we would ask wherein the difference exists between the old and the new. No one could accuse Mr. Swinburne of being unscrupulous, but that he has been careless in reading our article there seems to be no doubt, for his letter merely begs the question at issue without in the least degree affecting our contention that anybody is free to use the material of which Mr. Swinburne says the resistances are made.—EDS. ELEC. REV.].

Gas Engines v. Electric Motors.—As we go to press Messrs. Bilbie, Hobson & Co. write as follows:—"We note your remarks in reference to the circular we issued *re* gas engines *v.* electric motors. You ask the question whether our circular fairly represents the matters of gas engines *v.* electric motors? We have the reputation of being straightforward people, although we are, as you say, enthusiasts on our own side. This we consider is natural and reasonable. As you promise further particulars in a later issue, we will not trespass greatly on your space until then. We may say, however, that the figures we have given are, to the best of our knowledge, correct. Our calculation of gas consumption of 20 cubic feet per B.H.P. on 10 H.P. load was on an engine of, say, 19 to 20 B.H.P. working at half load. In modern gas engines about this size the gas consumption per B.H.P. on full load does not exceed 16 cubic feet. When you have given the further particulars which you promise, we shall be pleased to reply in detail, but we, in the meantime, still adhere to the advantages claimed in our circular."

Appointments.—Mr. J. K. Bock, who has been chief assistant at West Ham from the commencement of the scheme, was unanimously appointed borough electrical engineer, *pro. tem.*, by the West Ham Town Council on Tuesday last week.

Mr. C. W. G. Little, chief construction engineer of the British Thomson-Houston Company, Limited, has been appointed on the managerial staff of the British Electric Traction Company, Limited.

Obituary.—We hear with regret of the death of Mr. William Stiff, senior partner in Jas. Stiff & Sons, of London Pottery, Lambeth, which took place on the 19th ult. The business will continue to be carried on under the same style by the surviving partner of the original firm, Mr. Ebenezer Stiff, with the assistance of the three junior members of the firm, Messrs. Sydney J., James A., and W. Frederick, Stiff.

(*Continued on page* 197.)

BARROW-IN-FURNESS ELECTRICITY WORKS.

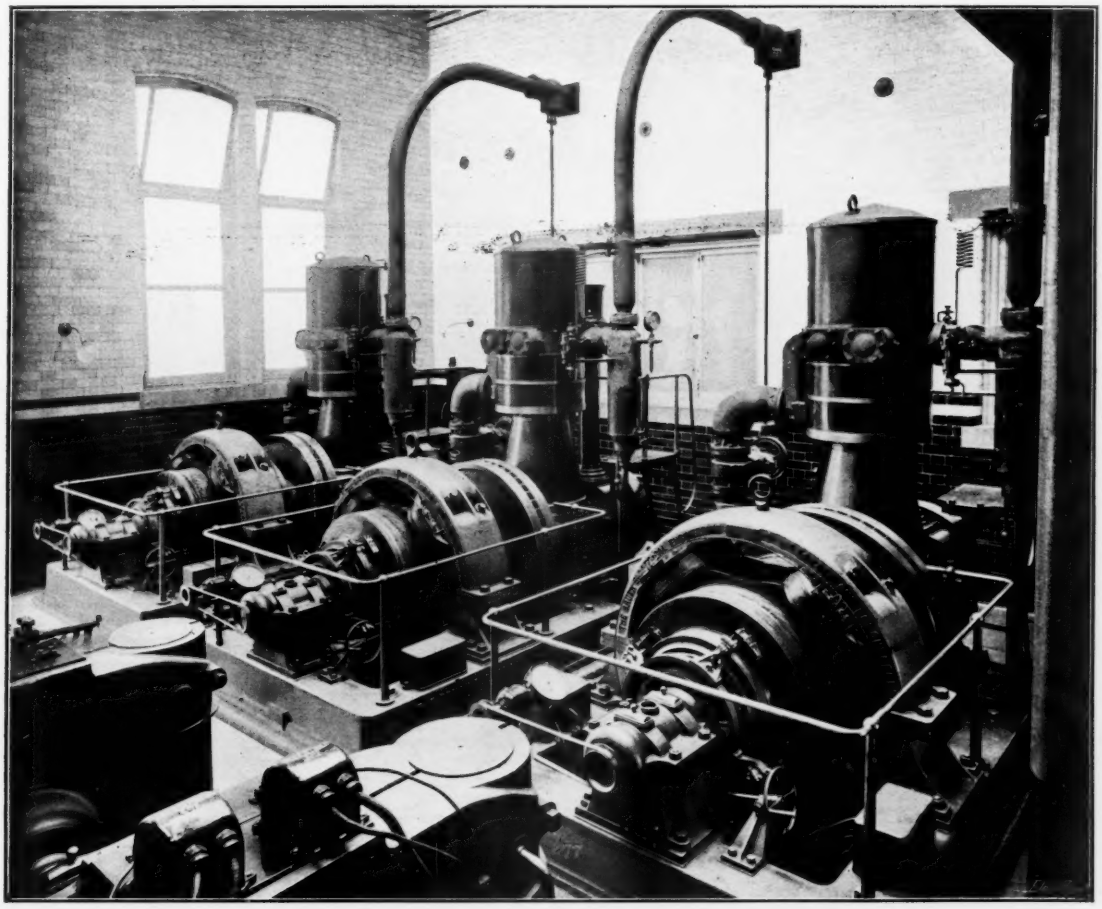
The introduction of electric lighting into Barrow has been under consideration since December, 1897, when the Local Government Board held an inquiry into the question of a loan of £30,000 for this purpose. Thanks chiefly to the exertions of Councillor J. P. Smith, the scheme was rapidly pushed forward; Messrs. Kincaid, Waller & Manville, the consulting engineers to the Council, decided in favour of a high pressure direct current system with rotary transformers in sub-stations, and distribution on the two-wire system at 220 volts. The high pressure system was rendered necessary by the nature of the district, in which there are densely populated centres some distance from one another; in two cases—one to Walney Island and one to the docks—the mains will have to cross salt-water channels.

The station is situated in a central part of the town, with a view to supplying the greater portion of the demand direct; in point of fact, the demand has so rapidly increased since the station was informally set to work in February last, that already extensions are in progress almost equal to the original capacity of the works, for supplying the business quarters at low pressure.

The buildings were designed by Mr. W. H. Fox, the borough engineer. The boilers were supplied by Messrs. Babcock & Wilcox, Limited, and are three in number, of their usual pattern; each boiler has a heating surface of 1,218 square feet, and is to work at a pressure of 160 lbs. per square inch. On account of the nature of the site, it was found necessary to arrange the stoking space between the boilers and the engine room—a not very desirable plan.

There are two three-throw feed pumps, made by Messrs. Hayward, Tyler & Co., each capable of delivering 1,000 gallons of water per hour against the full boiler pressure; these are driven by steam, with the usual duplicate steam and feed piping, and are situated in a pump room next the boiler house. There is a cast-iron feedwater storage tank over the pump room, with a capacity of about 9,000 gallons.

The chimney is 200 feet high, 6 feet in diameter, and is lined half way up.



Barrow-in-Furness.—Fig. 1.—General View of Engine Room.

The steam pipes form a ring main in the boiler house with single pipes to the engines, and are of mild steel; the stop valves are of Fletcher's make, and are all of cast-steel, except a few small ones of gun-metal. The exhaust pipes are carried in a trench, and terminate in a vertical pipe carried up the side of the chimney. A Green's economiser is installed, having 168 tubes in two sections of 84 each; the scrapers are driven by a small motor.

A 5-ton travelling crane was also supplied under Messrs. Babcock & Wilcox's contract.

There are at present three generating sets, each consisting of a single-crank vertical compound engine of Raworth's "Universal" type, direct coupled to a four-pole "Universal"

dynamo (see fig. 1). The output of each set is 75 KW., at 340 revolutions per minute. The engines are familiar to our readers, and need not be described; the dynamos have toothed armatures, and are wound on Mordey's patent system for 1,100 volts, 68 amperes. The commutators are of large diameter and short length; carbon brushes are used. It has not been possible to make accurate tests of the steam dynamos as yet, but they are guaranteed to give a commercial efficiency of 84·5 per cent., with a steam consumption of 24·9 lbs. per E.H.P.-hour at full load, 25·5 at ¾ load, and 30·5 at ½ load, all non-condensing. These figures include the energy required for exciting the field magnets, which is taken from the low pressure mains.

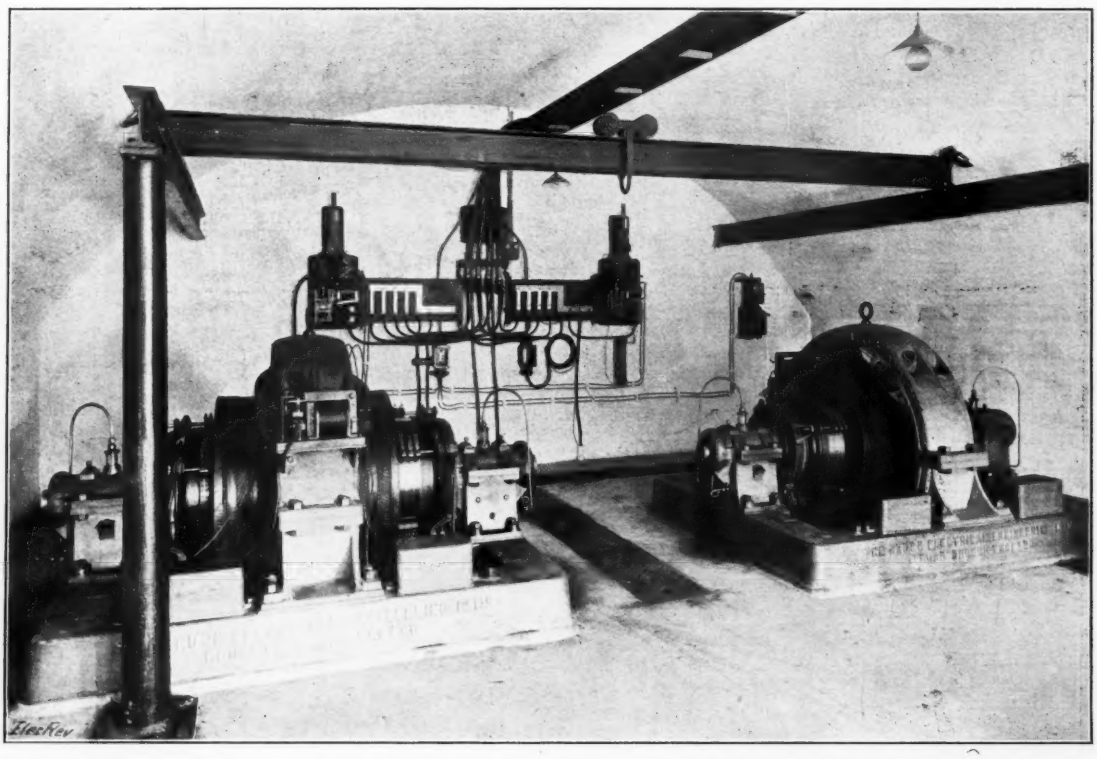
An additional set is on order for extensions, consisting of a 150 KW. low pressure generator made by Messrs. Bruce Peebles & Co., and coupled to a Willans engine.

There is in the engine-room a variable-ratio motor-transformer, taking power from the high pressure mains and supplying current at pressures from 250 to 350 volts, for charging the battery. This transformer consists of two 2-pole "Universal" machines coupled together.

centre. The latter is fitted with ammeter, single-pole switch, auto. max. cut-out, single-pole fuse, two-way single-pole switch for cutting out starting resistance, field switch, and field regulator—all on the high pressure mains; the low pressure switches are on the low pressure board at the right. On the transformer panel there is also a high pressure starting switch and resistance; this is used for starting any of the transformers, including that in the station, and is provided with an automatic release, so that when the two-way feeder switch is thrown over from the starting bus bar to the main bus bar, the resistance switch is disconnected and returned to the off position.

Each feeder panel is provided with a large dial voltmeter connected with the low pressure mains at the feeding points, and with ammeter, single-pole switch, cut-out, fuse, two-way switch, and regulator, all on high pressure, and a low pressure "firing" switch for controlling the long range switches in the sub-station.

All high pressure parts are protected by plate glass shields, as will be seen in the detail view of a feeder panel (fig. 5), to ensure the safety of the operator.



Barrow-in-Furness.—Fig 2.—Sub-station under Archway; Two 52-kw. Rotary Transformers.

The battery includes 135 cells made by the Tudor Battery Company, type L B 11, with a discharge capacity of 100 amperes for six hours, and a maximum discharge rate of 175 amperes for a short time. The battery is arranged in an ingenious manner; as it is highly desirable that the cells should all be in one tier, while the space at command was insufficient for this, a light upper floor of wooden bars was put in the battery room, to support a number of the cells.

The battery works on the network, and is able to take the whole of the light load. It can be used if necessary to work backwards through the transformer, and so to supply the high pressure sub-stations.

The switchboard was constructed by the Electric Construction Company for the Brush Company, and is of the type used at Shoreditch and elsewhere; there is a separate feeder panel for each transformer sub-station, and the transformers are controlled on what has become familiar as the "Oxford" system from the generating station, with automatic switches made by the Electric Construction Company.

There are three generator panels (on the left hand in our illustration, fig. 4) and a station transformer panel in the

The low pressure board consists of four panels, and is fitted with the usual battery charge and discharge switch (with two bars moving over the same contacts, actuated by separate handles), voltmeter, ammeter, switches, and fuses.

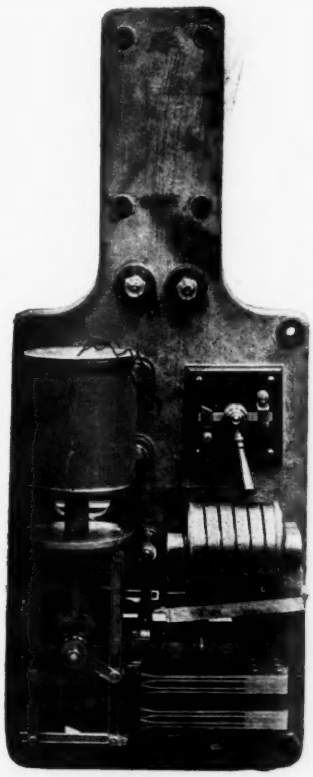
There are at present only three sub-stations, but more are contemplated. In each there are two similar rotary transformers of the Brush Company's make, with double-wound armatures and single fields (see fig. 2). Four of the rotaries are 52 KW. four-pole machines, and two are 25 KW.; they give no trouble in any particular, not even by sparking, and are running extremely well. One of the sub-stations is close to Furness Abbey, about two miles from the works.

The larger rotaries have field frames of the same size as the 75 KW. generators, and the armature is of similar construction. As usual, the transformer is started up, and the low pressure side is switched on the service mains, entirely from the generating station. At times of light load the transformers are shut down.

This is, we believe, the first installation of this kind carried out by the Brush Company, and the complete success

which has attended their maiden effort must have been very gratifying to the company.

Each sub-station board carries a long range switch,



Barrow-in-Furness.—Fig. 3.—Automatic Switch in Sub-Station.

actuated by a solenoid in series with the pilot wires. On short circuiting the voltmeter wires with the "firing" switch in the works the switch is closed, connecting the secondary of the transformer with the network. An automatic cut-out releases the switch when the current falls to zero or reverses. Each switch has also been provided with a maximum demand meter, which is not seen in our photograph, fig. 3. There are no batteries in the sub-stations.

The whole of the cables were made and laid by the British Insulated Wire Company, Limited, and are paper insulated and lead covered; the feeders are concentric, and are drawn into earthenware pipes, chiefly of Doulton's make. The longest feeder, which runs to Furness Abbey, is of 0·062 square inch cross section; the remainder are 0·048 square inch. A low pressure feeder from the works to the nearest point of the network is 0·15 square inch. The distributors are of three sizes, but chiefly 0·5 and 0·25 square inch, and are laid usually on both sides of the roadway, on the solid system.

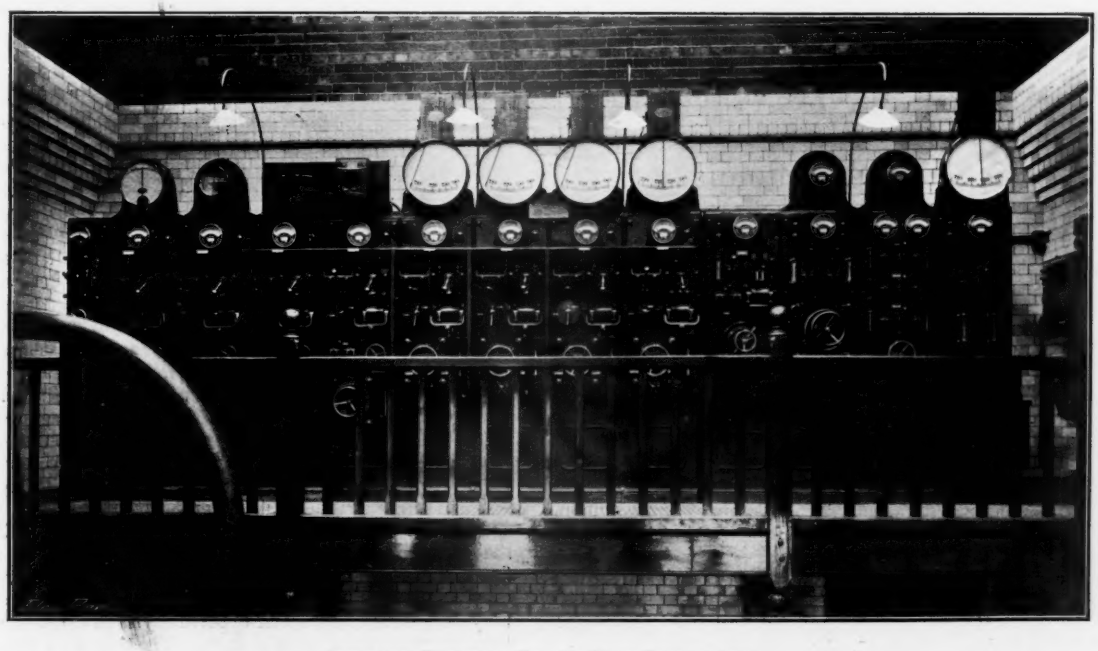
There are at present 21 arcs for public lighting, arranged in series on the 1,100-volt mains, along the chief business streets; the posts, of which we give an illustration (fig. 6), are similar to those in use at Edinburgh, and carry two glow lamps in addition. The glow lamps are substituted for the arcs at midnight by means of an Edmunds' switch. The lamps were made and erected by Messrs. Crompton & Co., Limited, with British Insulated Wire Company's cables. Amongst other large buildings the Town Hall is supplied, but no dock lighting has been taken up at present; nevertheless the plant would have been fully loaded up in the early spring if the street lighting had been in use, and the extensions will certainly be required before next winter.

Mr. H. R. Burnett was appointed electrical engineer to the Council at an early date, and is now the resident engineer. The work was carried out by Mr. O'Brien for the Brush Company, under the superintending engineer, Mr. R. A. Dawbarn, while Mr. Forrest represented the British Insulated Wire Company.

In conclusion, we beg to tender our thanks to Messrs. Kincaid, Waller & Manville, the consulting engineers, and to the various contractors who have kindly afforded us particulars of the undertaking.

EVAPORATIVE CONDENSERS.

We are sorry we cannot reproduce the whole of Mr. Oldham's recent paper on "Evaporative Condensers" read before the Institution of Mechanical Engineers. The evaporative condenser is necessarily also a surface condenser, but differs from this in having a limited supply of water. For condensation



Barrow-in-Furness.—Fig. 4.—Main Switchboard.

with vacuum, the cooling water must be 20 to 30 times the weight of the steam condensed. In the evaporative condenser the latent heat of the steam to be condensed is transferred as latent heat to the cooling water which disappears. The exposure of the cooling water to, preferably, a moving atmosphere, enables the air to carry off some of it as vapour, and water cannot exist as vapour without latent heat. But it is not simply requisite to absorb the latent heat and leave water at 212°.

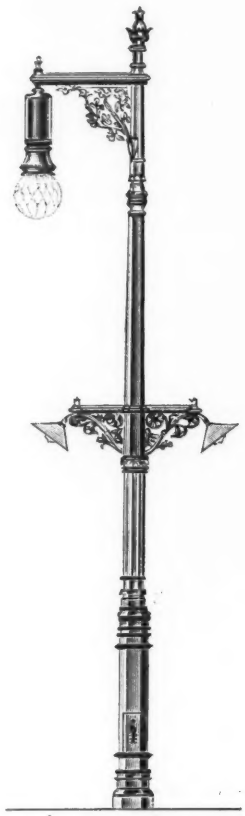
This would not produce the vacuum which is aimed at, and it is therefore requisite that, besides transferring latent heat, there must be a transfer of sensible heat. To effect this the steam must be cooled to about 100°. Obviously much of the success of an evaporative condenser depends upon the efficient covering of the pipes with thin films of water and the complete movement of the steam inside such pipes. Also the movement of the external air should be provided for. The movement of the air is very sluggish, especially in hot weather, and it is often remarkably sluggish when most laden with natural moisture. Such conditions are inimical to successful working.

In water-cooling towers considerable success has attended the employment of fans to compel atmospheric movement and promote evaporation, and it seems to us that if the evaporative condenser were enclosed in a light casing and exposed to a mechanically-produced movement of air its operation would be made more certain. The sides of the casing might be made to open in windy weather, so as to save the fan power, which would not, however, be great. The Fraser condenser is one which does make use of fan draught. An apparatus for 600 H.P. employs four fans of 66 inches diameter run at 300 r.p.m. The ground space occupied is 1 square foot per 5 H.P. The Thiesen condenser is also fan cooled. About

Barrow-in-Furness.—Fig. 5.—High Pressure Feeder Panel.

one-seventh of the steam condensed is required in the shape of cooling water, and the fan power required is about 2 per cent. of the total power.

A minimum of 1 square foot of tube surface per 8 lbs. of steam per hour is provided. About 20s. per H.P. is the cost of evaporative condensers.



Barrow-in-Furness.—Fig. 6.—Lamp-post.

The cooling tower for cooling large quantities of water has the disadvantage that the water requires to be raised to a considerable height, and in its fall through the apparatus it gives back no useful energy.

Evaporative condensers call for much less pumping. Evaporative condensers must be placed, as a rule, some distance from their engines. They introduce the risk of air leakage at the numerous pipe joints which are necessary, and it is essential that special care be taken in this respect, so as to minimise air leakage. The exhaust pipes should be well painted. On the discussion which ensued on the reading, various speakers expressed themselves somewhat unfavourably. It is easy to understand this, for in applying the principle of condensing it is not merely sufficient to provide so much tube area and so much cooling water. The water and the surfaces must be brought properly together, and the steam on the other side of these surfaces must be made to touch such interior surfaces and circulate properly. We have seen a surface condenser absolutely useless for lack of a bit of sheet-iron spreading plate to prevent the exhaust steam going too directly through the condenser; hence the importance of carefully considering all details of the arrangement. Happy indeed is the engineer who can run a perennially flowing stream through his surface condensers! We are much inclined to agree with Mr. Fraser that it is not necessary to secure very thin films of water flowing over the tubes. Thin films may entirely dry off; they are always apt to be partial in their covering effect, and they do not offer any better opportunity than thick films for the absorption from them of heat. The thin film idea is, in fact, probably one of those mistaken ideas which arise from want of sufficient thought. The maximum thickness of film is, of course, reached when gravity would pull the water off a tube at its horizontal diameter against the adhesion which prompts the water to flow round the pipe and only drop off at the lowest point.

NOTES.

(*Continued from page* 192.)

City and Guilds of London Institute.—At a meeting of the Council of the City and Guilds of London Institute held on Monday afternoon, it was resolved to confer the Fellowship of the Institute (F.C.G.I.) upon William J. Pope for the valuable and original chemical research work which he has done since he gained his diploma of Associate of the Institute; and upon Arthur E. Childs for the services he has rendered in developing several new branches of engineering industry. The Fellowship of the Institute is conferred by the Council upon those who, having obtained the Associateship of the Institute and spent at least five years in actual practice, produce evidence of having done some original and valuable research work, or of having otherwise contributed to the advancement of the industry in which they are engaged. According to a note in the *Times*, the diploma of Associate of the City and Guilds Institute (A.C.G.I.) was awarded to the following matriculated third-year students of the Central Technical College who have completed a full course of instruction as prescribed by the Council:—Civil and Mechanical Engineering.—F. E. Whittle (Siemens medal), A. P. Ackery, H. C. Armstrong, R. Arthur, C. L. Bryden, E. W. Cook, W. H. P. Craig, H. Dunell, S. Gowan, P. Hackforth, J. Hammersley-Heenan, G. A. Hicks, A. G. Hounsfield, J. I. Hunter, J. A. Parker, A. Reynolds, S. Robertson, F. Shœberlein, T. B. Smith, A. D. Tisdall, F. N. Trier, E. Way, W. White. Electrical Engineering.—F. C. Hounsfield (Siemens medal and premium), W. H. Arundel, C. Calliphronas, F. Fernie, R. MacKay, F. Miller, J. St. V. Pletts, L. Redmayne, F. G. Sharp. Chemistry.—F. G. H. Billows, A. Bunce, E. J. Fairhall, S. S. Napper, F. J. Plymen, Miss A. R. Rollinson, L. P. Wilson.

Personal.—Mr. A. G. Marshall, late assistant engineer at the House-to-House Electric Supply Company, Limited, has joined the staff of Messrs. Preece & Cardew, consulting engineers.

It is stated that Mr. P. O. L. Moll has resigned his position of traffic manager of the Direct United States Cable Company, and that the resignation has been accepted.

The Crown Agents for the Colonies have appointed Mr. W. Phillips (late assistant engineer and electrician of the Bangkok electric lighting station, Siam, and late consulting electrician to Howarth Erskine, Limited, engineers, Singapore) assistant engineer at Lagos. He leaves on the 12th inst.

The Wolverhampton Town Council has confirmed the appointment of Mr. C. E. C. Shawfield as electrical engineer, at a salary of £300 per annum.

Mr. B. H. Jenkinson has resigned his position as manager to the National Electric Wiring Company, Limited, for the purpose of going into business with Mr. A. C. Hands, manufacturer of electric light fittings, art metal work, switchboards, switches, and accessories, Garlick Hill, Cannon Street, E.C.

Effects of Lightning on Beech Trees.—The consulting botanist of the Royal Agricultural Society of England, in investigating a disease affecting beech trees, had found that the damage was primarily due to the effects of lightning. The committee has suggested the desirability of publishing a note in the journal on the susceptibility of different species of trees to injury from this cause.

The New Knights.—Sir W. H. Preece, and Sir G. H. Murray, secretary to the General Post Office, journeyed down from London to Osborne on Wednesday to be personally invested by Her Majesty with the insignia of the Orders to which they were recently admitted. A very fine portrait of the former gentleman appears in *Fielden's Magazine* for this month.

Good Business.—We read in an evening paper that the London County Council may, in the autumn, have before it a proposal to spend £1,000,000 upon the conversion of its tramways to electric lines.

NEW COMPANY REGISTERED.

Deansgate Foundry, Limited (63,058).—This company was registered on July 24th, with a capital of £25,000 in £1 shares, to acquire and take over as a going concern the business now carried on by Edward Bennis, under the style or firm of the "Deansgate Foundary Company," at Deansgate, Bolton, Lancashire, to enter into an agreement with the said vendor, and to carry on the business of electrical and mechanical engineers, machinists, fitters, founders, millwrights, smiths, wire drawers, annealers, ironmongers, tool makers, &c. The first directors (each with one share) are:—Edward Bennis, Beech Hill, Astley Bridge, Bolton, engineer; Ernest H. Lowden, 28, Victoria Street, Westminster, engineer; Alfred W. Bennis, 28, Victoria Street, Westminster, engineer; Edwin Haslam, 21, Mawdsley Street, Bolton, auctioneer; John Balshaw, 22, Acresfield, Bolton, solicitor; William Geipel, M.I.E.E., Parliament Mansions, Westminster; Edwin J. Taylor, 75, Seventh Avenue, Manor Park, Essex, clerk. The number of directors is not to be less than three nor more than seven; the first are Ernest H. Lowden, William Geipel, Alfred W. Taylor, and Edward Bennis (managing director); qualification, £500; remuneration as fixed by the company.

CITY NOTES.

City and South London Railway Company.

The half-yearly meeting of this company was held at Winchester House on Tuesday, Mr. C. G. Mott, presiding.

The Chairman, in moving the adoption of the report, which was printed in the Electrical Review last week, regretted that he could not again announce an increased dividend. This was partly due to the loss of traffic consequent upon the tramway competition. Ordinary business competition they did not object to, but the competition to which they had been subjected by the London County Council—who had taken over the tramways, and were reducing the fares below a legitimate paying point in order to draw from the electric railway—was not a fair or business competition. This had, to some extent, reduced the earnings of this line during the half-year, but the punctuality, comfort, speed and other facilities which they gave on the City and South London Railway, were so appreciated by the public that even with that competition they were able to hold their own, to show an increase in the number of passengers of 61,121, and in the receipts of £392. They had fair reason to be satisfied with such a position. The most important part of this railway was the question of its future extensions. Hitherto, it had been a purely isolated line connected with nothing, three miles in length and dependent purely upon the local residential traffic. The extensions which would be opened in a few months would connect them with almost every railway system which had its terminus in the metropolis. They hoped this would justify the recommendations which they had made from time to time, and the authority given to the board to spend the money upon these extensions. They expected the extension to Moorgate Street to be opened in October. That to Clapham was following close after it. The work was getting on exceedingly well, and they had full hopes that they would be able to get it opened in January. Then they would have a system of a very different character in every respect to the present one. He hoped that the traffic, as it developed, would prove of a thoroughly remunerative and satisfactory character. The extension to Islington had been started. It would take some time to carry out, probably another year and a half, or perhaps more. That extension would be one of the most valuable pieces of their line, and the most valuable extension made or to be made. To work all these lines they had to put down a very large additional generating plant. They had endeavoured to make it as up to date as possible. It had been very well thought out by their engineer and others, and he hoped that it would not only do its duty well, but economically—more economically than the present plant which was now 10 or 12 years old, and since the time it was put down a great many improvements had been made in electrical machinery. They were providing also new rolling stock, which was necessary. They had the full complement of the carriages in their possession, and the engines were making considerable progress. They issued the capital for the Islington extension in March, and it was all subscribed at the price at which it was issued, and it had placed them in a position to go on with that line without any possible delay. They had for some time been in treaty with the Brighton Company for the connection of their station at London Bridge with the Brighton Company's station. Considerable difficulty had arisen as to the mode in which that was to be constructed, and they had now settled it satisfactorily, and had agreed that it shall be the joint property of the two companies, owned and worked jointly. They proposed to do very much the same thing with the Great Northern and City Railway Company at the Old Street station. Though not yet settled, the general terms were agreed upon, and there would be a joint station there, so that passengers may walk from one platform to the other. The board was doing its best to make complete the connections of this line with the other railway systems, and to do it, both in construction and future working, as economically as possible. Turning to the accounts, the capital account showed that the amount received on shares during the half-year was £248,722, that being the gross nominal amount taking the shares of the last issue as issued at par. Then they received for debentures £48,000, and in premiums £22,114, making a total receipt of £318,836. They had expended during the

half-year £182,518, and there had been written off as discounts £130,023, particulars of which appeared in the statement No. 4 in the report, making a total of £312,541. The receipts from passengers showed an increase of £392, and there were various other small increases making the total increase for the half-year £573. The expenditure showed increases in maintenance, traffic expenses, general charges, law charges, and rates and taxes, and decreases in locomotive and carriage expenses, making a net increase in expenditure of £237. The receipts had increased by £573, and the expenditure by £237, leaving a net increase of £336. This half-year the interest on increased number of debentures had to be paid and an increase of the dividend upon the first preference shares. They had to pay £2,276 increased interest and dividends upon these, and against that they had increased interest of £2,333, chiefly arising from arrangements of certain contractors and others to pay interest during the half-year. That had added to their ordinary interest receipts so that they amounted to £2,333 leaving a balance of £193 to the good altogether. In regard to the percentages of working, there was one very satisfactory feature this last half-year, and that was the slow but steady increase in the number of passengers carried per train. It was most important on all railways to fill up the trains and have as little dead weight as possible. He doubted if there was a railway anywhere which could show such a large percentage used as the City and South London. Their seating capacity was 96 per carriage, and they had carried an average this half-year of 47½, which was very good, compared with only 46½ in the previous corresponding half-year. The receipts per train-mile had increased from 7s. 4½d. to nearly 7s. 6½d. The receipts per passenger were 1·90d. in 1898 and 1·91d. this year. There was not much room for increase under this heading. The total working expenses had decreased from 56·57 to 56·36, they went down steadily, and that spoke volumes for the management. The expenses per train-mile had increased from 1s. 3·92d. to 1s. 4.17d. The locomotive charges and the traffic expenses remained almost exactly the same percentages as before. There was a general increase in passengers carried in every division. They carried passengers at varying fares from 1d. to 3d., and there is a steady increase in all those fares all over the line, and at all hours. After the meeting closed a special meeting would be held for turning both classes of preference shares into preference stock, which were all fully paid up. At a later meeting they would ask them to convert the £225,000 ordinary shares because they would be all paid up very shortly, the last instalment becoming due that day. The dividend also on the 5 per cent. preference shares of 1896, was for this half-year and the next, carried to capital account. He hoped that long before they had to meet the dividend on those shares they would have a large traffic on their extension to do so.

The adoption of the report was seconded by Mr. G. S. Grenfell, and carried unanimously, after Mr. Drake, a shareholder, had said complimentary things about the directors and officials, and one or two questions had been asked and answered by the chairman. One speaker asked whether there was no way of improving ventilation so as to remove the present "stuffiness" of which passengers complained, and another shareholder asked whether, when the extensions were carried out, the present fitful and unsatisfactory lighting of the carriages would be improved. The Chairman said that the stuffiness would only be found to exist when the trains were crowded, and that was noticeable on all railways at overcrowding times. As to the lighting, that matter had exercised the attention of the company perpetually since the opening of the line. The lamps were lighted with current direct from the line, and there was extreme difficulty in effecting satisfactory lighting. As soon as the extensions were ready, the arrangements made would ensure a perfectly steady light. The resolutions declaring dividends having been passed, the meeting became "special" for passing the necessary resolutions converting the preference shares into stock.

The usual vote of thanks closed the meeting.

Globe Telegraph and Trust Company.

The twenty-sixth ordinary general meeting of the shareholders of this company was held on Friday last at Winchester House, Old Broad Street, the Marquis of Tweeddale presiding.

The Chairman, in proposing the adoption of the report, said that the receipts showed a further increase as compared with the previous year. The total receipts, after deducting expenses, amounted to £197,890, as against £196,974, or an increase of £916. That was the more satisfactory when it was borne in mind that those figures compared with the receipts of a year which showed an increase of £10,000 over the preceding year. The expenses of working the Trust, which were never high, were £174 below those of last year. The net result of the year was that they were able to recommend the payment of a final dividend of 4s. 6d. per share on the ordinary shares, as against 4s. 3d. per share last year, in other words, in addition to the usual 6 per cent. on the preference shares, they had funds available for the payment of a dividend on the ordinary shares at the rate of 5¼ per cent., as against 5½ per cent. for the preceding year, leaving a balance of over £1,000 to be carried forward to the next account. That was the second time in the history of the company that they had paid such a good dividend. Turning to the more important investments held by the Trust, he said that their holding in the Anglo-American Telegraph Company had been further reduced since the last meeting by the sale of 10,000 nominal, of the "A" or deferred stock, the price being the highest such stock had reached during the last two years. Their holding in the Brazilian Telegraph Company had been largely increased, due almost entirely to the fact that the shares formerly held in the Western Brazilian Company had been exchanged for shares in the Brazilian Company on the basis of five shares in the latter company for every six ordinary shares of the former. They had also bought some additional shares in the Brazilian Telegraph Company on profitable terms. The debentures formerly held in the Commercial Cable Company, had been sold during the year, and the proceeds invested in some of the Brazilian shares, the sale of that stock realising a profit of £9,500. Their holding in the Direct United States Cable Company required a little explanation, for while their actual receipts from that company during the financial year had been a little less than those of the preceding year, the position of the company had decidedly improved, and they were paying a better dividend than for some years past. The fact was that for 1896-97, the company paid a very small interim dividend, and their final dividend, which they received at the beginning of last year, carried with it a bonus, which went to swell the receipts of the Trust for that year unduly as against the present. With reference to the Eastern and Eastern Extension Companies, a good deal of alarm had been created in the minds of shareholders by the proposed Pacific cable, but he was glad to say that they had received a positive assurance from the Colonial Minister that the Government did not intend to compete with those companies other than on fair commercial lines. They had sold 150 debentures of the Telegraph Construction and Maintenance Company at a profit of £450, and had invested the proceeds in the Brazilian shares, to which he had before referred. Their investments in other companies remained about the same, and it would be satisfactory to the shareholders to know that, notwithstanding the recent fall in the shares of some of the companies in which they had investments, their investments, as a whole, still showed a profit of nearly £700,000 over the capital.

Sir J. Pender, Bart., M.P., seconded the resolution, which, after a short discussion, was carried.

Edmundson's Electricity Corporation, Limited.

The second annual general meeting of this company was held on Friday last, at the offices of the company, Broad Sanctuary, Westminster, Mr. J. R. Wigham, J.P., presiding.

The Chairman, in proposing the adoption of the report, said that at the last annual meeting he submitted to them a short statement as to the formation of the corporation and its operations up to date. At that date several of their central lighting stations were nearing completion, and there had now been finished—in fact, during the last year they had completed no less than nine important stations, viz., at Folkestone, Winchester, Woolwich, Bromley (Kent), High Wycombe, Salisbury, Newmarket, Ventnor, and Chislehurst. Most of these had been working long enough to enable them to form an estimate of the results they might expect. At Folkestone the number of lights taken up had been so satisfactory that a fair dividend is assured upon the first year's working, a result seldom obtained on the first year's working of electric lighting stations. In most of the other towns the demand for electric light had been very satisfactory, and they all promised to give fair interest upon the capital invested within a very reasonable time. As the report showed, the directors had been encouraged by these results to take up the lighting of a number of other towns, for which they have been able to obtain the necessary powers, and during the present year several other stations will be completed and ready for working, including one for Guernsey, where a valuable concession under a special Act has been obtained, and where the prospects are particularly encouraging. The accounts spoke for themselves. The directors had been careful to take into account only such profits as had been realised as cash, but the balance-sheet showed a large sum, viz., £87,319, to the credit of the corporation for investments at cost. This item represents shares and debentures which the company holds in the various local companies, the face value of which is of considerably greater amount than that set down in the balance-sheet. There is also another large amount, viz., £67,129, expended upon unfinished work in various towns, which has also been taken at cost, the profit on which items will appear in future accounts. These two items constitute a substantial reserve profit, which, when realised, will be available for future dividends. He congratulated the shareholders upon the report, which clearly indicated that a very substantial measure of success had attended the operations of the corporation during the past year. On the last occasion he intimated that they would have to raise further capital. This they had done by the issue of debenture stock for £75,000, which was offered in the first place to the shareholders, and was largely subscribed for by them. It appeared to him that their debenture stock at 4½ per cent., secured as it was by the valuable property of this corporation, was an excellent investment. The directors now propose to issue the remainder of the authorised ordinary share capital. The amount already issued is £153,000, and it is proposed at once to issue the balance of £47,000. The shares of the company are now quoted at a premium of 15s., which is equal to about 10 per cent. premium, ex dividend, and it is proposed to offer this fresh capital to the present shareholders at par.

Mr. W. R. Davies seconded the motion.

Mr. T. Powell asked whether the directors had taken into consideration the question of entering upon electric traction. He had heard that the British Electric Traction Company had gone into electric lighting, and he thought he was correct in saying that the Isle of Thanet Company was also going in for electric lighting. Considering the unique opportunity this company had before it on the Isle of Wight more particularly, it certainly might be well to enter upon electric traction. He had often seen in the Electrical Review that their corporation met with opposition in its proposals for electric lighting in one quarter and another, and in view of this, it might be advisable for them to have two strings to their bow in this sense. If they were beaten by a municipality which proposed to take

upon itself the lighting of its particular town or district, the company might under those circumstances suggest the placing of themselves at the disposal of that town or district to carry out the work.

The Chairman said the question about traction was a very important one, and it had by no means escaped the attention of the directors. They had not taken it up with a view of carrying it out necessarily, but with the idea of giving it careful consideration. There were many things that had to be thought of before a matter like that was taken fairly in hand, one being the question of capital. To enter upon electrical traction successfully would require a very large capital. Of course there was nothing more natural, when a company was established and had large power houses for lighting, than that they should also desire to use that current for traction or *vice versâ*. But there were difficulties, however, to be overcome in connection with existing supply corporations and other matters.

Mr. Gripper said there were, of course, a great many ways of dealing with a local authority, and this company did not confine itself to one method by any means. In several cases where they had found the local authority had entirely made up its mind to stick to its own order, they had entered upon negotiations with it for letting the company carry out the works, the local authority finding the money, and granting a lease of the works for a certain number of years. If, for instance, a town was not very certain of being able to work the thing properly, it might be glad to get a company like this to put the works up and run them for three, four, or more years, the company undertaking that the municipality should incur no loss on them, that the interest and sinking fund they had to pay in respect of their loans would be paid by the company who would run the works and take what profit could be made out of them. It was, however, exceedingly difficult to get local authorities to allow companies to step in; they had a great idea that electric lighting was a profitable undertaking, and were inclined to keep the powers themselves. There was no doubt they were wrong in doing it, because very few local authorities were able to make a small station pay. The results that that corporation had got in connection with small stations were much better than those shown by any local authority. No local authority, with hardly an exception, had made both ends meet in the first year after it had carried out the works itself. When they started a moderate sized station in the town where people had always been afraid to go in for electric light, the first year must be regarded as satisfactory if there was no loss incurred. As a matter of fact, the schedule sent out with the report showed that in all the stations they had been running during the last six months—in nearly every case it being the first six months of their running—they had not only paid working expenses, but they had a small balance over as profit. Of course, if they could do that in the first six months, when the number of lights were small, they would get a further increase in the future. The motion was then carried unanimously.

A dividend was declared at the rate of 6 per cent. on the ordinary shares for the year ending March 31st, 1899, and a dividend of 1 per cent. being the balance of dividend unpaid on the ordinary shares for the year ending March 31st, 1898.

Mr. J. R. Wigham having been re-elected a director, Mr. W. H. May was re-appointed auditor, and the proceedings terminated.

House-to-House Electric Light Supply Company.

Mr. W. Page presided on Thursday, last week, over an extraordinary meeting of the above company held at Winchester House, for the purpose of altering the articles of association, by passing the following resolutions:—

"1. That the name of the company be changed to the Brompton and Kensington Electricity Supply Company, Limited. 2. That the 101st article of association be cancelled, and that the following clause be substituted therefor:—(Article 101).—The directors may, from time to time, at their discretion, borrow or raise money at interest for the purposes of the company, and may raise and secure such moneys and interest, and the repayment of such moneys, in such manner and upon such terms and conditions in all respects as they may see fit, and particularly may create, issue, make and give respectively any perpetual or redeemable debentures or debenture stock, or any mortgage or charge on the undertaking, or the whole or any part of the property, present or future, or uncalled capital of the company, provided that the directors shall not borrow or raise any sum of money which would make the amount borrowed or raised by the company and then outstanding, exceed the paid up capital of the company for the time being."

The Chairman, in moving the first resolution, said it was scarcely necessary to make any remarks as to the object of the change. The present name was that given to the company at its inception, about 10 years since, at which time the then board had very great ideas as to what they were going to do. They were not to confine their operations to Kensington and Brompton, but were to go all over the kingdom. They applied for provisional orders in Scotland and Ireland and other parts of England, but when the present board came into office they found it very desirable to abandon that policy and to confine their operations pretty much to Kensington, and finally to quite confine themselves to Kensington, and now they had no interest to speak of beyond Kensington and Brompton. Therefore, it seemed most desirable, for Stock Exchange purposes, that the locality of the company should be indicated by its title. He did not know that they had any other reason for changing it than that. When the district they supplied was thus indicated it would help to give a better value to the shares, because only those interested in the company now knew that they supplied Kensington and Brompton.

Mr. R. Davies seconded the resolution, and it was carried.

The Chairman then moved the second resolution, and said that under the old articles of association their present borrowing powers were £100,000. They had not reached that yet, but they thought when they were having a meeting, it would be desirable to bring themselves into line with other similar companies with regard to borrowing powers. It was a matter of finance in which he did not take a very deep interest, although they had several gentlemen on the board who were fully alive to all that went on, and they considered it desirable that this should be done.

Mr. W. F. Liesse seconded the motion.

Mr. Matthews asked if there were any debentures at present knocking about.

The Chairman said there were £50,000 debentures of 4½ per cent. redeemable, at six months' notice, at 107½. Probably one of their next operations would be to redeem them.

Mr. Matthews said he was very glad to hear that, and he would like to know when they issued new debentures, if the board would give the shareholders a pull over the outside public?

Mr. Davis said it had always been the custom of the board to give the shareholders a preference, and he did not suppose that they would depart from that principle.

The motion was then carried.

Consolidated Telephone Construction and Manufacturing Company, Limited.

The eighteenth ordinary general meeting of the shareholders of the above company was held on Thursday, last week, at Winchester House, E.C., when the chair was taken by Mr. A. H. Baker.

The Chairman said his duty was a very short one, because since he had come into the room he had heard for the first time of the resignation of his old colleague the chairman, Mr. C. L. W. FitzGerald. Hearing that only half an hour ago, and having been connected for so many years with Mr. FitzGerald, it was his intention, after moving the first resolution—without going into any details—to hand in his resignation to the shareholders so that they might fill up the vacancy with whom they liked. He would first ask the secretary to read the letter of resignation from Mr. FitzGerald.

Mr. C. Curtoys (the secretary) read Mr. FitzGerald's letter, which stated that the shareholders had, by their votes, informed him that they did not consider his services necessary, and under the circumstances he thought it best not to attend the meeting. In placing his resignation in the hands of the shareholders, he wished to state that the paragraph in the committee's report, which alleged that he resented any interference with the general manager, was absolutely untrue. When he joined the company 15 years ago he found it hard to raise even £500 on the assets, but they had since paid a great deal to the shareholders, and the assets were still worth £50,000. If the new directors did as well, he, for one, would not grumble.

The Chairman then put the motion that the report be adopted, and that a dividend of 1 per cent. per annum be paid.

Mr. H. Grewing seconded the motion, and it was carried.

The Chairman said he had now to leave the chair, and he did not know who was going to take the place. He could only say that he wished the company every success, and he trusted that the gentlemen who replaced them would make it more prosperous than they had done in the past. It had not been for want of trying that the company had not been more prosperous. They had tried to deserve success notwithstanding the comments of one or two shareholders, who were not satisfied with what they had done.

The solicitor invited Mr. Grewing, the remaining director, to take the chair, but on his declining, Mr. Stoop was elected by the shareholders as chairman.

Mr. Stoop said he was sorry it had been necessary for them to place him in that position, but it would be wise not to rake up any incidents which had occurred in the course of the performance of the duties of the committee. He was sure that they would all regret the death of Sir A. Armstrong, who was largely responsible for preventing the company being wound up. The committee had acquired the conviction that there was life in the old dog yet, and that the company could be made to flourish. Personally he felt grieved that he had been obliged to place himself in opposition to Mr. FitzGerald, for whom he had the most friendly feelings, and he trusted that that gentleman, when the troubles of the company were forgotten, would reciprocate these feelings. Mr. Baker had been a good and useful director for many years, but the committee felt itself obliged to assume a position of opposition to him. There were two gentlemen nominated as directors, viz., Mr. Hubert Jackson and Mr. C. Woolley, and he moved that they be elected directors of the company.

Mr. W. R. Lawson seconded the motion, and it was carried.

A Shareholder asked if Mr. Stoop would go upon the board, but that gentleman declared that it was quite impossible.

The auditors having been re-elected, the meeting closed.

Central London Railway Company.

The report for the half-year ended June 30th states that the expenditure has amounted to £396,908, the total to June 30th, 1899, being £2,841,985. The amount of £432,354 shown in the accounts as due to the Electric Traction Company, is for work done and plant supplied. Notice will shortly be given of the final call of £2 per share, which will be payable on September 1st on the partly paid ordinary and preferred capital. The whole of the main line and station tunnels are completed. The permanent way is in position throughout the up and down tunnels, and the lifts and gear for working them are being erected. The large buildings at the generating station at Shepherd's Bush are practically finished. The boilers, engines, and dynamos are now in position, more than half of the electric locomotives are ready, and rapid progress is being made with the electrical

installation generally. The carriages are being constructed, and several are ready for delivery. The station buildings are well in hand, and, with the exception of Shepherd's Bush, Davies Street, Chancery Lane, and Post Office, are approaching completion. In February last the engineers were enabled to make arrangements for the construction of the steel roof of the Bank station and public subways, to be proceeded with by day as well as by night, and this work has now been completed. The underground booking hall is also in a forward state. The Bill promoted by the company for an extension of time for the completion of the works, and for an increase in the sum authorised to be paid as interest during construction, which was submitted to the proprietors for approval at the last half-yearly meeting, has passed both Houses of Parliament unopposed, and now awaits the Royal assent. The Bill promoted by the North-West London Railway Company for an underground electric line from Cricklewood to the Marble Arch, with a subway connection to the Central London station there, has also been approved by Parliament.

The eighth half-yearly general meeting of the shareholders of this company was held on Wednesday at Westminster Palace Hotel, Sir Henry Oakley presiding.

In proposing the adoption of the report, the Chairman said that during the half-year they had spent £396,000 on the certificates of the engineers, which made their total expenditure, down to date, £2,841,985. They were nearing so rapidly the end of their work, that it was necessary to make the final call upon the shareholders on September 1st. The position of the railway was that it was fast approaching towards completion, and they would see by the engineer's report the amount and the nature of the work that had been carried on during the last half-year. Happily they had met with no trouble or disturbance to impede the steady progress of the works. As he had explained on previous occasions the nature of the work rendered it unavoidably slow. The whole of the underground work must be carried out and completed before they could commence that on the surface. Everything had gone on very satisfactorily, and several members of the board had the pleasure a week ago of travelling from one end to the other over the permanent way, and of seeing that they were in a substantial condition towards reaching the final end of the work. At the Mansion House, where they had met with some trouble, everything underground had now been happily accomplished, while the whole of the railway was supported by their steel roofs, and the shafts to reach the lower station were completed. The larger tunnels for the stations were also finished, so that what they might term the substantial fabric of the undertaking at that point had passed all chance of danger or further difficulty. The City authorities helped them most materially by allowing them to work on a small portion of the surface by day as well as by night, thus shortening the time of construction by at least three or four months. It would be interesting to know that when the directors made the journey the other day from end to end they found the atmosphere of the tunnels thoroughly enjoyable, in fact, it was far more pleasanter than on the surface. At Shepherd's Bush, their Western terminus, their works had gone on exceedingly well, the whole of the large buildings were finished, the boilers were fixed, the dynamos, the engines, and the motors for hauling the trains were fast approaching towards completion, and the place now looked a busy hive of machinery that promised well for their future ability to carry on the railway successfully. Eighteen out of the 20 motors were ready, the electric fittings were advancing, and all the cables necessary for the conduct of the electric force from one end to the other were upon the ground and in hand. There was, however, still a vast amount of detailed work to be done, and such work could only be carried on slowly and with the greatest possible care and circumspection. The carriages were being completed, and there was no doubt they would be ready by the time they required them. The stations were probably the least forward, for the reason they could not undertake them until the underground work was completed, but they were all making good progress. In conclusion, he said that another company had obtained a Bill to form a railway from the Marble Arch to Cricklewood, which would be connected with their line at the former place.

Lord Rathmore seconded the motion.

In reply to questions, the Chairman said that he must forbear from making any promise as to when the line would be open, for the reason that he could get no promise from the engineer. He told them the work was so difficult and so important, and needed so much careful attention, that while he undertook that every possible diligence should be exercised he thought it unwise to make any promise. They were, however, justified in saying that the railway was rapidly advancing towards completion.

The report was then adopted.

Imperial Tramways Company, Limited.

Extraordinary general meetings of the shareholders of this company were held on Saturday at the offices of the company, Clare Street House, Bristol, Mr. George White, chairman of the company, presiding.

The Chairman explained that the first meeting was called for the purpose of making a few formal alterations in the articles required by the committee of the London Stock Exchange in connection with the directors' application for a quotation of the company's ordinary and preference shares and debenture stock. The resolutions confirming the articles were carried unanimously. At the second meeting a resolution was passed as to new capital (£100,000) which it may be necessary to raise during the present year. The date of issue depends upon the works.

The National Telephone Company, Limited.

The directors' report for the half-year ending June 30th, 1899, to be presented to the shareholders at Cannon Street Hotel, on Thursday August 10th, at 12 o'clock noon, reads:—

"The income accrued in respect of the business of the half-year amounts to £602,146 3s. 6d., as compared with £538,959 1s. 6d. for the corresponding period of 1898, being an increase of £63,187 2s. The working expenses for the half-year amount to £332,257 1s. 1d. as compared with £303,101 6s. 10d. for the corresponding period of 1898, being an increase of £29,155 14s. 3d. The net result for the half-year (after deducting the Post Office royalties amounting to £53,859 17s. 3d.) is a profit balance of £211,029 5s. 2d. as compared with £186,184 8s. 11d. for the corresponding period of 1898, being an increase of £24,844 16s. 3d. The rentals carried forward for unexpired terms of running contracts amount to £651,741 5s., as compared with £565,620 5s. 4d., at the corresponding period of 1899, or an increase of £86,120 19s. 8d. Out of the available balance of £178,963 7s. 9d. shown by the net revenue account (No. 3) the board will recommend the payment of a dividend at the rate of 6 per cent. per annum, less income-tax, on the first and second preference shares, 5 per cent. per annum, less income-tax, on the third preference shares, and 6 per cent. per annum, free of income-tax, on the ordinary shares. The board also propose to transfer £60,000 to the reserve fund, and to carry forward the balance of £5,213 7s. 9d. The sum of £372,329 5s. 5d. has been expended on capital account during the half-year in the erection of 10,479 additional exchange and private lines, and in the construction of underground lines. The rapid and continuous growth of the company's business already established in the great commercial centres of the kingdom, and the possible expansion of telephony predicted to follow the initiation of the new policy of the Government, raises the question of additional capital somewhat earlier than appeared to be necessary until recent developments have made it possible to act upon a reasonable forecast of the future. The board have therefore determined to submit the matter to the proprietors at the forthcoming general meeting, and will then, in accordance with the accompanying notice, propose a resolution to the effect therein indicated. Retiring directors.—At the general meeting four directors retire, and, being eligible, offer themselves for re-election, viz, the Right Hon. Lord Harris, G.C.S.I., G.C.I.E., Mr. Charles Swain Agnew, Mr. George Hunter Robertson, and Sir Albert Kaye Rollit, M.P. Retiring auditors.—The auditors, Messrs. Welton, Jones & Co., also retire, and are eligible for re-election. Proxies.—A form of proxy is enclosed for the signature of the shareholders who may be unable to attend the meeting, and it is particularly requested that the proxy may be signed and returned to the secretary, Oxford Court, Cannon Street, London, E.C., so that he may receive it not later than Monday, August 7th. The special direction of any shareholder will be obeyed."

Edison & Swan United Electric Light Company, Limited.

The sixteenth annual meeting of the shareholders of the above company was held at the Cannon Street Hotel on Friday, when the chair was occupied by Mr. J. S. Forbes.

In moving the adoption of the report, the Chairman said that those who attended those meetings from time to time would have learned the importance in their company of a certain reticence. They were surrounded by extremely keen competitors, and there was no particular reason why they should reveal more than would satisfy the proprietors, without prejudicing them with outside competitors. The profit and loss account showed a credit balance of £44,792, and after providing for the interest on the debenture stock, there remained a balance of £33,607 available for distribution. They had already paid an interim dividend of 6 per cent., and would declare a final dividend at the same rate. With regard to the profit and loss account, they would see that the stock brought into the account was £148,110, while the stock in hand on June 30th, 1899, was £160,000, this item thus having been swelled to the extent of £12,000. That seemed a large sum to be locked up in stock, but it meant lamp fittings and a variety of things spread over a large number of towns in which they had depôts. Although in the aggregate it represented a large amount of money, yet parcelled out in a great many places it was a moderate amount, and not more than the business requires. Wherever they had a depôt they had to have a large stock of fittings, as any shareholder would find on going to their depôt in London. They had no misgivings as to the stock, as the book value of the stock was each year depreciated reasonably, and if it was judiciously realised there would certainly be no loss, but probably some profit on the book amount.

The Earl of Lichfield seconded the motion, which was carried.

The Chairman next moved, "That a dividend be, and is hereby declared on the 'A' shares of the company, at the rate of 6 per cent. per annum in respect of the six months ending June 30th, 1899; making, with the interim dividend paid on February 24th, 1899, 6 per cent. on the 'A' share capital of the company as now paid up, in respect of the year ending June 30th, 1899."

This was also seconded by the Earl of Lichfield, and agreed to.

In announcing that the retiring director was Mr. J. W. Swan, the Chairman said that he had a message from that gentleman. Mr. Swan had devoted a great deal of his time in his own laboratory to studying and improving the lamp. Of course a man of his great experience and scientific attainments was a very desirable aid to the company, and he wished him to say that in his opinion at that moment, the lamp made at the works at Ponder's End was the very

best electrical lamp in the world. Mr. Swan had tested the lamp with every kind of lamp made, and his conviction was that their lamp was the best.

Mr. Den moved the re-election of Mr. Swan as a director, and it was agreed to.

Replying to a vote of thanks, the Chairman said he must not forget to show his appreciation of the work done by the staff, to whom they owed a debt of obligation.

W. T. Henley's Telegraph Works Company, Limited.

An extraordinary general meeting of this company was held at Cannon Street Hotel, on Monday, July 31st, Mr. Sydney Gedge, M.P., presiding. The subjoined resolutions were brought forward as special resolutions:—

1. That each of the existing fully paid shares of £10 each in the capital of the company be divided into two fully paid shares of £5 each.

2. That the following article be inserted in the articles of association of the company immediately after Article 8:—"8a.—All shares in the capital of the company shall be held upon the terms that all, or any of the rights, privileges, advantages or restrictions attached to any class of shares may be affected, altered, modified, or dealt with in any manner with the sanction (whether previously or subsequently given) of an extraordinary resolution as defined by Section 129 of the Companies Act, 1862, passed at a separate general meeting of the holders of the shares of that class. To any such general meeting all the provisions of the articles of association of the company relating to general meetings shall *mutatis mutandis* apply, but so that the necessary quorum shall be one-tenth the number of the members of the class holding, or representing by proxy, one-tenth of the nominal amount of the capital paid on the issued shares of the class, and that the holders of the shares of the class shall have the like right of voting as the holders of ordinary shares would have at an ordinary general meeting of the company."

3. That the capital of the company be, and it is hereby increased, from £180,000 to £200,000 by the creation of 24,000 new shares of £5 each, to carry dividend as from September 1st, 1·99, or from such later date or dates as the directors shall determine.

4. That the agreement dated July 19th, 1899, and made between George Sutton on behalf of the holders of the preference shares of the company of the first part, Arthur Edward Salmon on behalf of the holders of the ordinary shares of the company of the second part, and the company of the third part be and the same is hereby sanctioned and ratified.

5. That the said 24,000 new shares and the 6,000 preference shares of £5 each (arising from the sub-division of the 3,000 preference shares of £10 each created by special resolution in September, 1891) shall, as from September 1st, 1899, rank together as one class of shares, and shall be called preference shares, and shall confer on their holders the rights following in lieu (as regards the holders of the said 6,000 shares) of the rights now belonging to them under the articles of association, namely:—

(*a*) The holders of the preference shares shall have the right to receive a fixed cumulative preferential dividend at the rate of 4½ per cent. per annum on the amount paid up, or credited as paid up thereon, such dividend to be payable on March 1st and September 1st in every year, and the right on a winding up to receive in priority to any payment in respect of the ordinary shares payment of (1) all arrears of such preferential dividend, such arrears to be calculated down to the commencement of the winding up; (2) interest at 4½ per cent. per annum on the capital paid up, or credited as paid up thereon, as from the commencement of the winding up to the time of the actual payment of such capital, and (3) a sum equal to the amount of such capital, but the preference shares shall not confer on the holders thereof any further or other rights to or in the profits or assets of the company.

(*b*) Notwithstanding anything in the articles of association contained the holders of the preference shares shall not be entitled to be present or vote at or to receive notices of any general meeting of the company unless (1) The published balance sheet and accounts of the company for the financial year next preceding such meeting show that the dividend on the preference shares has not been earned or (2) Default shall have been made in paying the dividend on the preference shares or any part thereof for the financial year next preceding such meeting or (3) A resolution for winding up the company or any resolution which directly affects the rights or privileges conferred by the preference shares on the holders thereof is to be proposed at such meeting.

6. That notwithstanding anything in the articles of association contained the directors of the company be and they are hereby authorised and directed (in case an extraordinary resolution within the meaning of Section 129 of the Companies Act, 1862, shall be passed at a separate general meeting of the holders of the preference shares sanctioning and ratifying the said agreement of July 19th, 1899) to apply a sum of £30,000 out of the moneys standing to reserve account in the company's books in paying a special bonus or dividend of £100 per cent. on the capital paid up on each share arising from the sub-division of the 3,000 preference shares created in September, 1891, to the person who shall on the date of the confirmation of this resolution as a special resolution be the registered holder of such share or entitled by transmission thereto, but so that the acceptance by any person of such bonus or dividend in respect of any share shall be deemed to be an express acknowledgment that the said agreement and the special resolutions set out in the schedule thereto are binding upon him and upon every person claiming through or under him any interest in such share.

7. That the directors be and they are hereby authorised to offer 6 000 of the new shares to the holders of the existing preference shares in proportion to the number of such shares held by them upon condition that upon the issue of such new shares to the holders of existing preference shares the same shall be paid up in full by applying the aforesaid special bonus or dividend in payment up of the amount payable on such shares as by the said agreement of July 19th, 1899, is provided.

8. That subject to the provisions contained in the last preceding resolution the directors be and they are hereby authorised to issue the new shares on such terms at such times and to such persons as they shall in the interest of the company consider proper.

9. That notwithstanding anything contained in the articles of association the directors be and they are thereby authorised to make such regulations as they shall think fit providing for the surrender by any member of the company whose shares shall have been sub-divided or have undergone any alteration or modification of rights of his certificate for such shares and for the issue to him in lieu thereof of a new certificate and any regulations so made shall be binding upon each of the members of the company.

The Chairman, in moving the adoption of these resolutions, congratulated the shareholders that, as a company, they wanted more money, which they could employ profitably. The business had been increasing—not by leaps and bounds, which were apt to be uncertain—but year by year, for eight or nine years, until it had arrived at a very satisfactory position, as shown in the balance-sheet adopted in February last for 1898. For the year 1896 the available profits were over £20,000, in 1897 £24,000, and nearly £28,000 in 1898. He was not going to reveal secrets, nor to indulge in prophecy, but the business had gone on increasing to such an extent during the first seven months of 1899, compared with the business in the corresponding period of last year, that if it continued, as they hoped it would, in the same proportion during the remaining five months, it would not be an increase of £4,000 or £8,000 in the available profits, but a larger increase than that upon which he would have to congratulate them next February. There was therefore ample security for the preference dividend which it was proposed to create upon the preference shares in the company. The scheme might seem perhaps a little complicated, and he therefore proceeded to explain it in detail. They proposed to turn their £10 shares into £5 shares, upon the recommendation of Stock Exchange gentlemen, for the convenience of investors, believing that they would increase the market for their shares by giving them a smaller nominal value. The £10 shares now stand at £25 and upwards. The alteration would not affect shareholders in the least pecuniarily. When increasing the capital on several former occasions they had offered new shares to the shareholders *pro rata* at something like 20 per cent. below the market price, and all the necessary capital had been promptly subscribed. But there were objections to continuing that course. The company was doing so well now that on the old terms they would be raising the additional capital at a high rate, and as the directors had paid 14 per cent., and had a prospect of increasing that dividend, they felt their security for preference dividend was so good that it would be a better plan to issue the new capital by the creation of 4½ per cent. preference shares. Then came the difficulty connected with the existing £30,000 preference shares. When that capital was issued it was necessary to pay 7 per cent. They did not then dream that the capital would require to be raised to £300,000, and no provision was made for increasing that preference stock by further issues. With a view to getting rid of that stock they had arranged liberal terms with the holders. That £30,000 was valued in the Stock Exchange list at £58,000, and the board determined to ask the shareholders to give them power to give £60,000 in the new shares to carry interest at 4½ per cent. He thought it was not a bad bargain for either the ordinary or preference shareholders. The speaker referred to the great demand for cables and wires for telegraph, electric lighting and power purposes, and also to the Pacific cable project. The new capital would not be issued unless it was going to earn large profits and pay big dividends. By the scheme they not only provided for their present needs in an economical fashion, but kept the powers in their own hands of providing further capital without using anything like compulsion on stockholders. They proposed to offer the new shares to the shareholders in the first instance, and they hoped that shareholders would find the capital within the next few months. They had had to make large purchases of copper and gutta-percha, and the large increase of business necessitated a large expenditure for wages, &c., without immediate return in cash. Therefore, they wanted this additional capital. They had nearly completed the new buildings which were to be opened in October. They had an eye to future increase of business. If the resolutions were adopted they would come before an extraordinary meeting on August 15th, and after confirmation, applications for the new shares would be immediately invited.

General Hutchinson, C.B., seconded the adoption of the resolutions, and after a shareholder had recommended the exercise of caution in adding a large amount of new capital, and advised them not to be deceived by booms, the resolutions were carried *nem. con.* The usual vote of thanks closed the meeting.

Great Northern and City Railway Company.

The half-yearly general meeting was held on Tuesday at the Westminster Palace Hotel, Sir Charles Scotter, presiding.

In moving the adoption of the report, the Chairman stated that the progress of the works was in every way satisfactory. He had been favoured by Sir Douglas Fox, engineer to the company, with a detailed report dated July 28th, from which it appears, *inter alia*, that at the Regent's Canal the access heading and shield chamber had been completed, and everything was ready for the first shield, which was in course of being sent off from the maker's yard. The second shield, says the *Times* report, would follow within a week, and the remaining two were expected to be ready as soon as the contractors should be in a position to utilise them, it being their intention to run one tunnel somewhat in advance of the other. There had been some delay in the delivery of the shields. At Essex Road houses had been pulled down and the station site fenced off, and sinking operations would be commenced at once. At Drayton Park, possession of the land for the station site had been obtained, for temporary purposes only, from the Great Northern Railway Company, and an easement had been arranged for with them for the construction of permanent works on their property south of the station. Among other materials and plant, 200 tons of 16 feet tunnel segments were on the ground, and 80 tons of bolts had been delivered, while dynamos for the electric light were being fitted together. Referring to the delay in the delivery of the shields, the chairman remarked that everybody connected with trade and commerce was aware how exceedingly difficult it was to get any ironwork or mechanism completed within contract time. There never was a period, he supposed, in the history of this country when the iron and steel industries had been in such a prosperous state, and this enterprise was only suffering in common with all other railway companies and other large undertakings in this respect. Still, the engineer assured him that he was not, considering all the circumstances, dissatisfied with the progress which had been made. The accounts, professionally audited, contained a full statement of the financial position. In a short time, he added, the board would have to make another call, but it was a tacit understanding that the second call should not be made within a certain interval of the first, and, of course, due notice would be given.

The Earl of Lauderdale seconded the motion, which was carried unanimously.

Anglo-American Telegraph Company, Limited.

The directors' report to be presented to a meeting of proprietors at Winchester House on August 4th, at 2 o'clock p.m., reads as follows:—

"The total receipts from January 1st to June 30th, 1899, including the balance of £588 3s. 7d., brought forward from the last account, amounted to £202,728 7s. 5d. The traffic receipts show an increase of £255 as compared with the half-year ended June 30th, 1898. The total expenses of the half-year, including the repair of cables, &c., as shown by the revenue account, amounted to £61,027 4s. 3d., being a decrease of £589 2s. 3d, as compared with the corresponding period of 1898. The directors, under the powers conferred upon them by the articles of association, have, before declaring the net profits, set apart the sum of £12,000 to the renewal fund, leaving a balance of £129,701 3s. 2d. One quarterly interim dividend of 15s. per cent. on the ordinary stock, and of £1 10s. per cent. on the preferred stock, was paid on May 1st, 1899, absorbing £52,500, and a second quarterly dividend of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, amounting to £52,500 will be paid on August 1st, 1899. The balance of £24,701 3s. 2d. will be carried forward to the next account. The cables and landlines of the company are in good working order."

The Liverpool Overhead Railway Company.

The directors' report for the half-year ending June 30th, 1899, to be submitted to the twenty-second half-yearly general meeting of the shareholders to be held at the Law Association Rooms, 14, Cook Street, Liverpool, on Tuesday, August 15th, 1899, at 3 o'clock, reads as follows:—

"In presenting the half-yearly statement of capital and revenue accounts to June 30th, 1899, the directors have to report that the gross revenue receipts amount to £36,683 12s. 6d., and the working expenses to £24,924 5s. 8d. The number of passengers carried during the last two years is as follows:—

	Half-year ending Dec. 31st, 1897.	Half-year ending June 30th, 1898.	Half-year ending Dec. 31st, 1898.	Half-year ending June 30th, 1899.
First class	621,392	637,547	663,177	594,669
Second class	2,790,768	2,686,651	2,962,827	2,445,572
Workmen (special return tickets)...	1,055,330	1,148,743	1,268,917	1,435,038
Total	4,467,490	4,472,941	4,894,921	4,475,279

"There has been an increase in the number of passengers carried of 2,338, but a decrease in the receipts of £946, mainly due to the extension of the time during which workmen's return tickets are available, and to a decrease in the number of first class passengers, caused by the competition of the electric tramways. By consent of the Dock Board, trains are now run on the northern section up to 11.30 p.m. The Bill sanctioned by the shareholders at the last meeting for the equipment and working of the Waterloo and Great Crosby Tramways has passed both Houses of Parliament, and now awaits the Royal assent, and the work is being proceeded with.

Revenue Account.

Receipts from passenger traffic amount to ...	£35,960	5 3
Miscellaneous receipts	723	7 3
	£36,683	12 6
Less working expenses	24,924	5 8
	£11,759	6 10
Deduct interest on mortgage debentures ...	3,400	0 0
	£8,359	6 10
Add balance brought forward, December 31, 1898	4,586	1 5
Leaving available for dividend	£12,945	8 3

"Out of this balance your directors recommend the declaration of dividends at the following rates (less income-tax), payable on and after August 17th next:—

5 per cent. per annum on preference shares ...	£3,000	0 0
2½ " " ordinary shares ...	5,625	0 0

leaving a balance of £4,320 8s. 3d. to be carried forward to next half-year."

Certificates are appended to the directors' report, in which the engineer, Mr. S. B. Cottrell, certifies that the permanent way and rolling stock have been maintained in good order.

The City of London Electric Lighting Company, Limited.

In their half-yearly report the directors say:—"Your directors now beg to submit their half-yearly report to the shareholders, the issue of which has been deferred until the Select Committee of the House of Lords had given their decision on the provisional order for empowering the Charing Cross and Strand Electricity Supply Corporation, Limited, to supply electric energy in the City of London in competition with your company. Your directors regret that, notwithstanding the strenuous opposition of this company, the order has been confirmed. A copy of the speech of the company's counsel, Mr. J. H. Balfour Browne, Q.C., is enclosed. Under these circumstances your directors have been compelled to reduce the company's charges for electric energy to no higher prices than are scheduled in the Charing Cross Company's provisional order. This must have a very serious effect on this company's revenue, and your directors can only hope that the increase of customers will be such as to gradually mitigate the seriousness of the reductions. In view of the entire alteration of the position which has been brought about by the passing of the Charing Cross and Strand Corporation's provisional order, your directors will seriously consider the policy of extending your company's area of supply in various directions. The demand for electricity in other districts would employ your company's machinery during the times when it is now idle owing to the restricted demand in the City, and consequently your company would be enabled to charge lower rates than are now being charged in the Strand and other districts, and which would still be remunerative to your company. Your directors propose also to apply to Parliament, as soon as possible, for an Act to relieve the company of the obligations imposed by the Act of 1893 as to depreciation and reserve funds, imposing in lieu thereof no larger obligations than are imposed on other companies which have to keep their accounts in the form prescribed by the Board of Trade. Your directors, in view of the unknown effect which the abovementioned reductions in the price for electricity will have upon the company's revenue, have decided that it is inadvisable to declare an interim dividend on account for the six months ended June 30th last on the company's ordinary shares. Warrants for the half-yearly dividend on the company's preference shares will be posted on August 3rd, 1899. The interest on the company's debenture stock for the six months ended June 30th last has been paid. Your directors have appointed Mr. Philip Debell Tuckett, a very large shareholder, as a member of the board. The following statement shows the progress made by the company:—

Number of Customers and Lamps Connected

(after allowing for disconnections on account of removals, &c.).

	Dec. 31, 1893.	Dec. 31, 1894.	Dec. 31, 1895.	Dec. 31, 1896.	Dec. 31, 1897.	Dec. 31, 1898.	July 19, 1899.*
No. of customers being supplied ..	1,080	2,740	4,230	5,303	6,822	7,414	7 863
No. (equivalent) of 8-c.p. lamps connected	65,341	135,460	195,317	247,785	296,012	355,825	390,809

* The corresponding figures on July 20th, 1898, were 6,715 customers and 323,868 lamps.

On July 19th, 1899, there were in addition 12,432 lamps awaiting connection, on completion of the consumers' wiring, &c."

Chili Telephone Company, Limited.

The annual meeting, held at Winchester House, E.C., on Tuesday, was presided over by Mr. G. Keith.

In moving the adoption of the report, which appeared in the Electrical Review in abstract last week, the Chairman said that the period under review had been anything but favourable for successful business in Chili. In July last year the financial difficulties of the country brought about a suspension of the gold standard and the sudden return to paper money. Since then, the currency in which the company's rates had been collected had been at a large discount. The value had been as low as 11½d., and the average 14½d. as compared with 17½d. for the previous year. The business had not suffered so much in volume as in value. The subscribers had increased from 4,463 to 4,486, and the profit in Chili was about 5 per cent. less than in the previous year. Every year the revenue suffered more or less from the irrecoverable amount written off against subscribers in arrears. That amount had been unusually heavy during the year, and the sales business had not been so large. All these things, brought about by the fall in the value of the currency, had told against revenue. They had to pay for their instruments and material imported in sterling. Increase in currency value of salaries and materials had, with the lower rates of exchange, added largely to the year's expenditure. If allowance were made for all those things, the profit in Chili had been well maintained, but when converted into sterling, its value came out at a decrease of £3,890 compared with the previous year. This was practically a loss imposed on the company's business by the sudden return of Chili to paper money. During the year £5,000 debentures had been issued to defray the cost of certain switchboard work. The result of the year's working was that after placing £1,340 to reserve, they recommended a 3 per cent. dividend for the year. The result was disappointing, but at the same time it was satisfactory to know that it was entirely due to the fall in exchange, and not to any falling off in business. With the value of the dollar the same as for the previous year, they would have paid the same dividend as for that year. The debenture issue matured on March 31st, and it had been extended for five years upon the same terms. The condition of the plant allowing subscribers to be connected up at small cost, had helped in some degree to counteract the effect of the currency upon their accounts. The rates to users were fixed according to the 1895 Conversion Act fixing the par value of the dollar, but with the alteration in the value of that, they were giving attention to the adjustment of their charges. Since the beginning of the year the revenue had been improving, and the prospects of the business were very bright. The rise in copper and other products had stimulated business

and that was favourable to increased rates. Altogether the outlook was more favourable.

The adoption of the report was seconded and carried, as were also resolutions declaring a 3 per cent. dividend, and re-electing the retiring directors and auditors. The usual vote of thanks closed the meeting.

Hobart Electric Tramway Company.

The report of the directors for the year 1898, submitted at the annual meeting held in London on 19th ult., stated that the revenue for 1898 amounted to £12,725, as against £12,380 for 1897, being an increase of £345, while the working expenses amounted in 1898 to £8,940, as against £8,853 for the previous year, being an increase of only £87. After payment of debenture interest, administration and other expenses in Hobart and London, there is a small loss shown of £90, repairs to the rolling stock having been very heavy during the past year. The revenue for the current year is steadily increasing even over that of last year.

Submarine Cables Trust.

An extraordinary meeting of the second certificate holders of the Submarine Cables Trust was held at Winchester House, Old Broad Street, on Friday afternoon, for the purpose of electing a new trustee to fill a vacancy in that body.

The Marquis of Tweeddale, who presided, said he had to propose that the vacancy be filled by the appointment of Mr. Clement Sleyd Colwin, C.S.T.

This was seconded by Mr. Pember, and agreed to.

Nernst Lamp, Limited.

An extraordinary general meeting of this company was held at Winchester House, Old Broad Street, E.C., on the 28th ult., when the directors submitted their report and balance sheet. The object for which the company was formed, viz., the flotation of the Nernst Electric Light, Limited, having been accomplished, the chairman, Mr. Cyril Wanklyn, stated that it had been decided that the company should be wound up voluntarily and the assets divided amongst the shareholders. It was proposed that 21,500 shares in the new company should be held in trust by the chairman, until certain negotiations with Prof. Nernst for the acquisition of his royalties on all the English business were completed.

The Chairman having moved the adoption of the report and accounts, the motion was seconded by Mr. Drake, and after some discussion, was passed. Resolutions to the effect that the directors should receive 3,500 shares, and the solicitors 1,000 shares, and that 21,500 shares be allotted in trust to Cyril Wanklyn, the chairman, were passed; and it was resolved that the company be wound up voluntarily, W. Chaplin, Dashwood House, being appointed liquidator.

Official Announcements re Companies.

The following have been struck off the Register of Limited Liability Companies:—

Akester Electro-Motor and Accumulator Company, Limited.
Anders' Telephone Company, Limited.
Danison Auto-Telegraph Machine Syndicate, Limited.
Economic Electric Speciality Company, Limited.
Electrical Plant, Limited.
Globe Electric Company, Limited.
Hermite British Electro-Bleaching Company, Limited.
Lineff Electric Traction and Lighting Syndicate, Limited.
Mexican Gas and Electric Light Company, Limited.
New Electricity Supply Company of Croydon, Limited.
Omnibus and Tramcar Electric Lighting Company, Limited.
Phœbus Electric Battery Syndicate, Limited.
Rogers Arc Lamp Company, Limited.
Self-Generating Electric Vehicle Light Syndicate, Limited.
Tayler-Smith Electric Company, Limited.

Notice is also given in the *London Gazette* that unless cause is shown to the contrary within three months, the following companies will likewise be struck off the register:—

"Blot" Electric Accumulator, Limited.
British Electrical and Industries Company, Limited.
British Electrical Cycle and Motor Engineering Company, Limited.
Electrical Investments Trust, Limited.
Electric and General Exploring Syndicate, Limited.
Electric Transformer System, Limited.
Feed Water Purifier Syndicate, Limited.
Franco-English Motor Car Factory Company, Limited.
Leatherhead Electric Lighting and Power Company, Limited.
Maxim Foreign and Colonial Motor Syndicate, Limited.
Phœnix Accumulator Syndicate, Limited.
Pioneer Motor Car Syndicate, Limited.
Practical Primary Electric Battery Syndicate, Limited.
Randall Telephone Syndicate, Limited.
Rottingdean Electric Lighting and Power Company, Limited.
Safety Incandescent Lamp Syndicate, Limited.
South Manchester Electric Supply Company, Limited.
Walton-on-Thames Electric Lighting and Power Company, Limited.
X Ray Syndicate, Limited.

Aluminium Company, Limited.

The report for the 12 months ended June 30th shows a net profit of £19,801, after paying the debenture interest and writing off £2,076, the amount at debit of the suspense account. The directors recommend a dividend of 20 per cent. on the share capital of £65,000, the balance of £6,801 being carried forward. The resolutions for the reduction of the capital by the extinction of three-fourths of the "B" shares, the remaining one-fourth ranking *pari passu* with the "A" shares, having been sanctioned by the court, the arrangement has been carried out, and the existing "B" shares will participate in the dividend now declared. The amount, £15,000, by which the capital is reduced, owing to the re-arrangement of the "B" shares, is applied in reduction of the cost of the works at Oldbury. A sum of £11,388 is applied in reduction of the amount at which patent rights stand in the books of the company. This is the sum realised by sale of patents in Germany and Canada during the past year.

Waterloo and City Railway Company.

The report for the half-year ended June 30th states that the gross receipts, less Government duty, amounted to £13,114. From this amount the London and South-Western Company have retained £4,690 in respect of the working expenses, leaving the sum of £8,424 payable by them in order to provide, under the agreement of March, 1894, for a dividend at the rate of 3 per cent. per annum on the company's ordinary and borrowed capital. The number of passengers carried during the past six months was 1,715,825, exclusive of season-ticket holders, who numbered 747 at June 30th last. Good progress has been made by the Central London Railway Company with the subways and approaches at the Mansion House and Royal Exchange, and these are expected to be completed by the end of the year.

Prospectuses.

During the past few days there have been several prospectuses before the public. That of Messrs. Browett, Lindley & Co. (1899), the well-known engineers of Patricroft, near Manchester, invited applications until yesterday afternoon for part of £50,000 6 per cent. preference and £50,000 ordinary capital, all in £1 shares. The nominal capital is £120,000, and of the present issue the vendors take 8,000 preference and 26,522 ordinary fully paid shares in part payment of the purchase price. It is intended to extend the works and at once purchase a considerable quantity of the most modern labour-saving tools and machinery. When these extensions are completed and equipped, the company will be in a position to make engines of the largest power, and to do a very large business under very favourable conditions. (The largest engine that could be built in the present works is about 2,000 H.P.) The record of the business from the first has been one of almost uninterrupted progress and expansion, and the firm has earned a very high reputation, placing it among the foremost firms in the country for its leading production, viz., modern engines of all the leading types for use with electrical generators for lighting purposes, and for the distribution of power for electric tramways and general purposes. Most of the leading firms of electrical engineers in the United Kingdom are customers of the firm, and large and important contracts have been carried out, or are in hand, for local authorities and private companies. A list of the most important is given with the prospectus. The orders in hand at the present time exceed in value those at the beginning of the year (which were then larger than usual), and are sufficient of themselves to keep the works fully employed for many months to come. The auditor's certificate shows that the result of the working of the business for the four years, 1894, 1895, 1896 and 1898 was an average annual profit of £3,111 15s. 6d. In 1897, the year of the great engineering strike, a loss was incurred of £2,630 0s. 11d., but this has been fully recouped, in part by the undivided profits brought forward from the previous year, and as to the balance out of the profits of the succeeding year. The profit, as above mentioned on the four years named, is equal to the rate of over 10 per cent. per annum upon the share capital and borrowed money employed in the business. The turnover of 1898 was far the largest in the history of the company. The present works have recently been valued by Messrs. Wheatley Kirk, Price & Goulty, as a going concern at £23,785 1s. 8d., and Mr. Wallis Rivers Goulty (who has retired from his firm) has been invited and has joined the board of this company.

The vendor company, who are the promoters, fixed the purchase price at £44,000, to £8,000 preference shares, £26,522 ordinary shares, and balance, £9,478, in cash. Out of the latter the vendor company will pay off the existing debentures. The present issue leaves for new works and plant, £41,954, and for working capital £14,046.

The prospectus of the Electrical Castings and Engineering Company is in circulation, inviting applications for the £30,000 capital in £1 shares, but the directors will not proceed to allotment until the sum of £24,000 has been subscribed. The vendor and promoter of the company is Mr. J. Hardie McLean, whose name is known to our readers as the late managing engineer of the Oxford Electric Company, and more recently as a director of and engineer to Messrs. W. Lucy & Co., Limited, of Oxford. The objects of the company are to carry on business as manufacturers of castings, forgings, and apparatus for electric lighting, power, and, in fact, all electrical and other purposes connected with electrical and general engineering developments and improvements. The prospectus refers to the great and growing demand which exists for castings and forgings for electrical purposes,

opening out a wide field for making a speciality of this class of work, which is said to have been much neglected up to the present. Mr. Hardie McLean has obtained special knowledge during his service with Messrs. Lucy to qualify him to act as managing director of the new concern in the construction of electrical castings, for Messrs. Lucy carried out lighting and traction contracts for a large number of important towns. The new company will acquire certain works, &c., already equipped, at Wednesfield, and will extend the same at a cost of £6,500. The vendor assigns certain electrical patents and the goodwill of his business as an electrical and mechanical engineer. The total consideration to be paid is £15,350 (£9,350 cash and the rest in shares). Above and beyond this the present issue is intended to provide £8,000 for working capital. Among the directors we observe the name of Mr. Thomas Parker, of Wolverhampton, who will devote a good deal of attention to the company's interests.

The Wiring Company, Limited, prospectus has been published in the Hastings local press, inviting subscriptions for £10,000 share capital (2,500, 6 per cent. preference; and 7,500 ordinary shares, all £1). The company has been formed primarily to work a free wiring contract with the Hastings Corporation. The company acquires in connection with its proposals, certain local installation businesses, and Messrs. Bruce & Wordley, the proprietors thereof, have been appointed managing directors for seven years. Mr. W. M. Mordey is consulting engineer and technical adviser to the company.

The Renewable Electric Lamp Company, with a capital of £150,000, has invited applications for its 50,000 6 per cent. £1 preference, and 100,000 £1 ordinary shares. The list closed yesterday. We refer to the concern in an article appearing in another part of this issue.

Tramways Union Company.—This company announce that the transfer of the Bucharest and Madrid undertakings is expected to be completed shortly, and that the company will then be put into voluntary liquidation. The 4½ per cent. first mortgage debentures of £100 each will thereupon become payable at £110, and the company, having already sufficient funds in hand, offer to pay the debentures off at once at £110 with interest to date on holders making application to the secretary.

Correction.—In our report of the annual meeting of the Langdon-Davies Electric Motor Company last week the word "Car" somehow or other slipped into the heading. Our readers probably noticed the error, as the Langdon-Davies Electric Motor Company does not make motor cars.

Bournemouth and Poole Electricity Supply Company.—The directors have declared an interim dividend on the preference shares at the rate of 4½ per cent. per annum, less income-tax, for the half-year ended June 30th last, payable 15th inst.

Metropolitan Electric Supply Company.—An interim dividend at the rate of 5 per cent. per annum, payable August 14th, is declared.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending July 29th, 1899, were £1,119 10s. 3d.; receipts for week ending July 29th, 1898, £890 3s. 8d.; aggregate, July, 1899, to date, £4,453 11s. 11d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending July 28th, 1899, were £3,404 1s. 4d.; corresponding period 1898, £3,021 1s. 3d.; increase, £383 0s. 1d.

The City and South London Railway Company.—The receipts for the week ending July 30th, 1899, were £958; week ending July 31st, 1898, £994; decrease, £36. Total receipts for half-year, 1899, £4,700; total receipts corresponding period, 1898, £4,757; decrease, £57. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending July 29th, 1899, were £253 8s. 4d.; week ending July 30th, 1898, £204 19s. 5d.; increase, £48 8s. 11d. Total receipts to date, 1899, £5,212 15s. 8d.; corresponding period, 1898, £4,174 6s. 3d.; increase, £1,038 9s. 6d. Miles of track open week ending July 29th, 1899, 3; week ending July 30th, 1898, 3. Car miles run week ending July 29th, 1899, 4,555; week ending July 30th, 1898, 3,967. Number of cars, week ending July 29th, 1899, 11; week ending July 30th, 1898, 10.

The Dublin United Tramways Company.—The receipts for the week ending Friday, July 28th, 1899, were as follows:—D. U. T. Co., horse cars, £2,127 19s. 10d.; ditto, electric cars, £1,367 19s. 3d.; D. S. D. Co., electric cars, £1,175 18s. 5d.; total, £4,671 17s. 6d.; corresponding week last year—D. U. T. Co., horse cars, £2,552 5s. 4d.; ditto, electric cars, £653 3s. 3d.; D. S. D. Co., electric cars, £1,065 18s. 3d.; total, £4,271 6s 10d.; increase, £400 10s. 8d. Aggregate to date, £18,090 13s. 3d.; aggregate to date last year, £17,865 9s 11d.; increase to date, £225 3s. 4d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 12 miles electrically, and 30 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending July 30th, 1899, amounted to £1,579; corresponding week last year £1,733; decrease, £136.

The South Staffordshire Tramways Company.—The receipts for week ending July 28th, 1899, were £656 17s. 7d.; aggregate receipts for 30 weeks, £19,220 15s. 3d.; week ending July 29th, 1898, £644 9s. 2d.; aggregate receipts for 30 weeks, £18,390 13s.

STOCKS AND SHARES.

Wednesday Evening.

Had our Market Notes been penned two days ago, it would have been a sorry tale that we unfolded. There has been, since we last wrote, a slump in electric lighting shares which shock the market all over, and caused a flatness among even the soundest descriptions. A general reaction, however, by this time has brought the greater number of shares to much about the same prices as we recorded a week ago, yet the aftermath of the fall remains, and so does the fact of the City of London Company having passed its interim dividend. That was the pivot upon which the market swung downward, the announcement coming as a kind of climax to the company's troubles. For our part, we are inclined to the opinion, which has also found favour in the Stock Exchange, that this unhappy incident has been unduly magnified by those pessimists who foresaw in this step the incipient signs of breaking-up of the City of London Company. But what else could the directors do? Face to face with a formidable competitor in the City, committed to a policy of drastic reduction of charges for lighting; handicapped in every direction by the high-handed action of the Corporation, surely the safest, most prudent, course to adopt was to reserve all the strength they possibly could in view of the unknown liabilities ahead. To have declared a dividend, however well the company could have afforded it, would, under such circumstances, have been an act of stupendous folly, a fact which must be patent to the most irritated shareholder. The directors are doing their best in a difficult situation, and however much they may have muddled matters in the past, their present line of action in striking boldly into the enemy's camp by applying for powers to conduct their operations in the Strand, shows that they mean to leave no stone unturned in their endeavour to redeem their company's old position in the Share list.

Charing Cross shares took part in the general fall, and Metropolitans also declined. It was, however, the declaration of its usual interim dividend by the latter company that helped to rally the general market. Chelsea Electric are still dull, sellers under 8, but Countys have kept their force remarkably well. The 6 per cent. Preference shares are a thought easier, allowing for the dividend of 6s. per share. Westminsters are a welcome exception in the flabby list, the price being 5s. better, as the shares are now ex dividend.

The telegraph market is very quiet, and almost the only changes noticeable are occasioned by the deduction of dividends. Anglo-American Preferred were picked up a little, the idea being that the stock looks cheap, as it returns an investor slightly over 5 per cent. at 114. In several cases the dividend was recovered as soon as it was knocked off, this being notably so with regard to the senior securities of the Eastern Telegraph Company. Eastern Ordinary stock recovered part of the £3 5s. per cent., deducted last Friday, but Eastern Extensions have been very quiet. The number of recorded bargains each day is rapidly dwindling now that the excitement in this section is calming down, but the "markers" in the Stock Exchange find that the decrease in this section is fully made up by the greater activity of the electric lighting market. Great Northern, of Copenhagen, developed weakness early this week on account of a seller having appeared where no demand existed for the shares.

The electrical railway department is characterised by a drop of two points in the price of Waterloo and City Ordinary. Some disappointment is felt that the company should only have paid the guaranteed dividend. Central Londons, too, are out of favour, although there are not many months left before the line must be completed. There is no feature to remark in City and South London. Among other traction shares British Electrics are dull, despite the daily witness that is being borne to the superiority of electric motive power over horseflesh. New General Electrics are 4; Potteries Electric Traction 14—15. At the meeting of the Metropolitan Railway stockholders the other day, the chairman announced that an electrical train would probably be tried within a couple of months on their system. The Metropolitan Districts Company is paying 3¼ per cent. on its 5 per cent. Preference stock, as against 4 per cent. a year ago.

Aluminium "A" weakened on the publication of an excellent showing for the past year, and the shares are looking cheap at their present price. Electric Construction shares quickly added the dividend to their price after its deduction, as did Consolidated Telephone Constructions, which had to recover six-fifths of a penny. National Telephone Ordinary, and the Third Preference shares advanced still further upon the causes to which we alluded last week, assisted by the issue of an excellent report. The Telegraph Manufacturing and Construction shares exhibit no quotable difference.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, July 26th.	Closing Quotation, August 2nd.	Business done during week ended August 2nd, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	62 — 65	61 — 64 xd	...	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	114 —115	113 —114 xd	114	113
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	13⅜— 14½	13⅜— 14½	14	...
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15½	15 5/16	15
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	108 —112	108 —112	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	188 —193	188 —193	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105½	104⅜
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼xd	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9½— 10½	10¼	9⅜
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3½%	3½%	11⅜— 12¼	11⅜— 12	...	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	151 —156	150 —155 xd	153	149½
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	99 —103	98 —102 xd	100	99
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	101 —104	101 —104 xd	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	115 —120	115 —120	...	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14½— 15	14½— 15	14⅞	14
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	116 —121	114 —119 xd	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	103 —106	101 —104 xd	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —105%	102 —105%	103	...
180,227	Globe Telegraph and Trust	10	4½%	4½%	5⅛%	10⅜— 11¼	10⅜— 11¼	11⅛	10⅞
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15 — 15½	15 — 15½	15½	15¼
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	29 — 31	30¼	29½
83,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	109 —112	109 —112	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½%	6 %	6 %	5¼— 5⅜	5⅜— 5⅝	5 9/16	5⅜
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12½— 13½	13 — 14	13½	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12½— 13½	13 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5⅜	5⅜— 5⅝	5⅝	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	99 —102	99 —102	100	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	¾— 1	¾— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4¼— 5¼	4¼— 5¼	...	...
151,783£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	100 —103	100 —103	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— 1	⅛— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	101 —104	101 —104	...	...
889,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	1 %	¾%	...	1⅛— 1½	1⅜— 1⅝	1½	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10⅝	10½— 10⅝	10½	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	103 —106	103 —106	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

80,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11	9½— 10½	10½	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅜— 6⅛	5⅜— 6⅛	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7⅛— 8⅛	7⅛— 8⅛	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	4½%	...	112 —114	112 —114	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	12 — 14	11 — 12	13¼	11⅛
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13 — 15	12½— 13½	13½	12⅝
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	123 —128	123 —128	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	11 — 11½	11 — 11⅛	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13½— 14½	13 — 14 xd	...	...
220,000	Do. 4½ % Deb. Stock, Prov. Certs (£60% to be paid) Rd.	...	...	...	...	52 — 54	51 — 53	...	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	7 %	5½— 6	5½— 5⅝	5 9/16	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	7½— 8½	7½— 8½	8	7⅝
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	8½— 9½	8½— 9½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3¾— 4	3¾— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7	6½— 7 xd	6 13/16	6⅝
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	105 —107	106½	106
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15½— 16½	14½— 15½	16	14⅛
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	15 — 16	14 — 15	14	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15½— 16½	15 — 16	15⅝	15½
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	16½— 17½	16 — 17 xd	16⅞	16⅜
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10 xd	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	4½— 4⅝	4 — 4¼	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½— 15½	14½—15½ xd	15	14½

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation July 26th.	Closing Quotation Aug. 2nd.	Business done during week ended Aug. 2nd, 1899. Highest	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	3½— 4	3¼— 3⅜	3¼	3⅛
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	18 — 19	17½— 18½	18	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	14 — 14½	14 — 14½	14⅛	13 13/16
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	13⅞— 14½	13⅞— 14½	14	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	127 —130	128½	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	1⅞— 2	1⅞— 2	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2½— 2⅝	2½— 2⅝	...	...
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½%	15 %	14½— 15½	14½— 15½	15 1/16	14 7/8
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10½— 11	10½— 10⅝	10⅝	10½
178,303	Do. do. do. £8 paid	10	...	...	...	8½— 9	8½— 8⅝	...	...
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	2⅝— 3¼	2⅝— 3¼	...	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	5½— 5⅝	5½— 5⅝	...	...
630,000£	City and South London Railway	Stock	1 1/16 %	1⅞%	2⅛%	67 — 69	67 — 69	68½	67¼
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	4⅜— 5¼	6½— 6⅝	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	3⅜	3⅝
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½%	6 %	6 %	2 — 2½	2 — 2½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½%	6 %	6 %	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	96½	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜xd	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½xd	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	101 —104	101 —104	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000 ...	2	...	...	...	5/8— 7/8	5/8— 7/8	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	24½— 25½	25 — 26	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	19 — 21	19 — 21	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21¾	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½%	3½%	3½%	8½— 8¾	8 — 8⅛	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13½— 14½	14 — 14½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	38 — 42	37 — 41 xd	39	38
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	104½	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9½— 9¾	9½— 9¾	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5¾— 6¼	5¾— 6¼	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	104 —107	102 —105	104¼	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10⅛.
British Aluminium, Ordinary, no market; 7 % Pref., no market.
House-to-House, 4½% Debentures of £100, 103—106.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13; 1st Preference Cumulative 6%, £5 (fully paid), 7¼—8. Debentures, 103—105. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 5/16—7/16.
Smithfield Market Electric, 2—3 nom.
*T. Parker, £10 (fully paid), 18¾.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, August 2nd.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	32/-	32/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	37/-	37/-	..
a Ammonia, Muriate (crystal) .. per ton	£26	£26	..
a „ „ .. .. per ton	£24	£24	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£26 5	£26 5	..
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a „ White Sugar .. .. .. per ton	£31	£31	..
a „ Peroxide .. .. .. per ton	£37 10	£37 10	..
a Methylated Spirit .. .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	8¼d.	8¼d.	..
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a „ Crystals .. .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
b Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis per lb.	8½d.	8½d.	..
c „ Tube (brazed) .. .. per lb.	10½d.	10½d.	..
c „ Wire, basis .. .. per lb.	8¾d.	..	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons.
e

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£88	..
g „ Wire (basis price) .. per lb.	10½d.	10½d.	..
g „ Sheet .. .. .. per ton	£88	£88	..
g „ Rod .. .. .. per ton	£88	£88	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	7/-	6/-	1s. inc.
h India-rubber, Para fine .. per lb.	4/1 to 4/3	4/0½ to 4/1½	inc.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	71/6	75/3	3/9 dec.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 .. per ton	£11 5	£11 5	..
g Lead, English Ingot .. .. per ton	£14 10	£14 10	..
g „ „ Sheet .. .. per ton	£15 7 6	£15 7 6	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 7	£8 7	..
d Mica (in original cases), small per lb.	1½d. to 6d.	..	..
d „ „ „ medium per lb.	1/9 to 2/6	..	..
d „ „ „ large per lb.	3/6 to 7/-	..	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd strip & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£146 10	£146 10	..
g „ foil .. .. per lb.	1/6	1/6	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/10	1/10	..
p White Anti-friction Metals—			
"White Ant" brand .. per ton	£40 to £70	£40 to £70	..
f Yarns, Cotton, Single 10lb. bundles pr lb.	7½d.	7½d.	..
j „ Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j „ Hemp, 3 ply 10 lbs. .. per lb.	3½d.	3½d.	..
j „ „ Russian, 10 lbs. per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove .. per ton	£12	£12	..
j „ Manila, 24 thread .. per ton	£32 10	£32 10	..
k Zinc, Sheet (Vieille Montagne bnd.) p.t.	£28 10	£28 10	..

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

THE MUNICIPAL ELECTRICAL ASSOCIATION.

Discussion on Mr. Snell's Paper on "Condensers for Electric Light and Power Stations."*

The Chairman (Mr. Rider) said he hoped those engineers who had adopted condenser plant, or were about to do so, would speak, so that they might have a first-class discussion.

Mr. Chamen (Glasgow) thought that the extra column in the table of cost was a very good suggestion. On the broad question of condensing compared with non-condensing he did not think there was much doubt that in all stations of the larger size they would have to use condensers. Apart from the question of economy, there was the nuisance to the surroundings. In Glasgow there had been considerable nuisance already. It had been impossible to prevent artificial rain being poured in considerable quantities into the streets at the time of a heavy load, and he nearly got into difficulty with his committee over it. They wished to know what he could do to prevent it, and he said the only thing was to suggest that people walked down another street. For the information of other engineers who might be in a similar fix, he might say he was not troubled any more. Mr. Snell had mentioned that in some place the pumps were being driven from high speed engines.

Mr. Snell: At Poplar they are about to be.

Mr. Chamen said it was a question which interested all of them very much. He had not seen how to join air and circulating pumps at present. He believed a marine engine fitted with air and circulating pumps only ran 120 a minute. As to evaporative condensers, he quite agreed with Mr. Snell that the difficulty was in having to put them at such a distance from the engine. Everything pointed to best results being obtained by getting the condenser close to the engine. Of course, there was the further practical difficulty, apart from the fact that any current set up in the exhaust leading to the condenser caused a great deal of loss of vacuum, of leakage from any joints which had to be dealt with. He wished Mr. Low had been there to have given information on points of that kind, because he had been experimenting in the matter, and the information he could have given the Association would have been most valuable. The arrangement of the exhaust pipe from the engine to the condenser had everything to do with the amount of vacuum getting inside the cylinder—the mere fact of opening suddenly from the exhaust pipe in the engine into a pipe of larger diameter spoilt the vacuum to a large extent; there was a whirl set up which had the effect of choking the vacuum, and this was got over by putting on a tapered nozzle. About the ejector condensers, Mr. Snell had not specifically mentioned the trouble of the oil getting into the condensing water, and having to be got out of such a large quantity. It was obvious that in the ejector arrangement all the oil in the exhaust steam got into the cooling tank. Another great objection to the ejector condensers, to his mind was, he did not see how they could possibly make tests of the efficiency of the engine plant. One gentleman who was strongly advocating the use of the ejector condenser, tried to explain to him that there was no difficulty whatever, and that it could be done by calculations from the temperature of the water; but he thought that argument was not quite good enough. Mr. Snell made some mention of the oil question, and here again he wished Mr. Low could have been with them. The question of using graphite in the cylinders instead of oil had received considerable attention from various people, and while it seemed successful to a certain extent, the last time he was at Rugby Mr. Low showed him the inside of an engine which had been run experimentally with graphite, and the internal parts were completely rusted out. The fact was that the engine had been left standing a short time, and the absence of all grease of any kind might be aggravated by the presence of graphite, and the result was rust. Mr. Low's conclusion was that if you keep an engine running always you may get on with graphite, but under the ordinary conditions of electric lighting plant graphite appeared to be rather dangerous. As to the type of condenser which they would have to use in future, he had come gradually to Mr. Snell's conclusion, that the cooling-tower arrangement was the best. They did not like to put the condensers on the roof for the reasons he had pointed out, although the arrangement had the advantage of giving them more engine room. He differed from Mr. Snell in one small point—he did not think he should put the condensing plant below the floor. The condensing plant was usually put away out of sight, and if they went down below they would see something they would rather not have seen. He preferred to have it, unsightly as it might seem, in sight of the engineer, just as he intended to have the sanitary arrangements in sight as one walked round. The more these details were open for inspection the better.

Mr. Wordingham (Manchester) said he felt that he could not refrain from complimenting Mr. Snell on the excellent paper he had read. It was thoroughly practical throughout and very useful, and the figures given in it would be useful to many of them. He entirely agreed with Mr. Snell as to the advisability of condensing; he thought the position he took up was quite unassailable. He thought also that he was right in advocating surface condensers as being the best. Quite recently he (the speaker) had had to consider the question of the type of condenser to use, and although the surface condenser was so much more expensive than the other types, there was no doubt its advantages were sufficient to compensate for them. He agreed with Mr. Snell's figures as to cost. The extra cost of surface condensers over jet condensers represented £8,000 at Manchester, but he came to the conclusion that it was worth while to have them. In the case of the large engines—about 3,500 H.P. each, with a considerable upward margin—he had arranged that the surface condensers should be driven from the engines, and each condenser should be in two independent halves, so that if one half broke down they would have another to work upon. Of course, with these engines there was none of the difficulty of high speed. They only ran 75 revolutions a minute. Mr. Chamen asked whether he thought the rise in temperature in the water was sufficient to enable one to determine accurately the efficiency of engines. He did not, and it was one determining factor which made him go in for surface condensers, so that he could measure the steam consumption. He did not believe in putting in tests which he had no possible means of carrying out. The oil filter required a great deal of attention, and he was afraid it was one difficulty in connection with surface condensers. He had put in all sorts of pains and penalties whereby the engine builders had to keep oil out of the boiler. Whether they would do it or not was quite a different matter. He did not believe there was any thoroughly satisfactory oil separator in the market at the present time.

Mr. Ellis (Bolton) also complimented Mr. Snell on his very able paper. This subject was extremely interesting to them at Bolton, inasmuch as they were near a river which measured about 5 feet wide by 9 inches deep. Up to the present time they had been absolutely unable to go in for condensing, but it was now necessary that they should do something in the matter, inasmuch as they were putting in engines of larger size. They had decided to put in a lodge big enough to condense the steam during the hours of light load, and they were at the same time preparing to put on cooling towers to work in conjunction with the lodge during the hours of heavy load. That was the only way in which they could get out of their difficulty at Bolton.

Mr. Barnard (Hull) remarked he was also very much interested in the paper of Mr. Snell, especially in the remarks about ejector condensers—not so much in the arguments for or against as in the practical methods of working which he assumed. He had been trying to work these ejector condensers on the lines laid down—that was, under the water seal—but he had found it preferable to work them without the water seal. He knew that he was working against the instructions of the makers in that matter, but he had found that since he had been breaking the water seal from the condensers he had not known failure in the vacuum, whereas he had failure previously. They did not rely entirely upon the water return valve, but he had put an air cock in the exhaust chamber of the engine, and he started the engine with the air cock open before opening the volume of water to the condenser. When he got a little pressure in the exhaust chamber he opened the water valve, and he invariably got his vacuum immediately. As soon as the vacuum showed in the gauge he closed the air cock of the exhaust chamber. Each engine had its own condenser, and they all discharged into a large iron pipe which had an open end. Another thing that he had not adopted was the automatic atmospheric exhaust. He had not the least objection to shutting off the column of water in their condensers at any moment on full load. The only result was, that they occasionally got a little back pressure in the exhaust.

Mr. J. Klein said that it might be of interest to state that a surface condensing plant, combined with a Klein cooler of the "Tower" type, was working at the Bristol Wagon Works. In this type of cooler the water was only raised to a height of about 20 feet, the tower surrounding the cooling stack being 60 feet high. The difference in temperature between the interior of the tower and the atmosphere outside caused a draught up the tower which supplied the necessary air for evaporating a portion of the water and for carrying away the vapour. Several towers of this type were working successfully in this country, and a large plant to deal with the condensing water for some 3,000 H.P. was being erected for the City and South London Electric Railway. These tower coolers occupied more space than the fan coolers, but their advantage was that there were no moving parts, and the draught was obtained without expenditure of power. Of course, where sufficient space was not available, fans must be used. As to the oil question, it was extremely difficult to separate the oil from the water after condensation. He had found that the best way of removing the oil was by a separator in the exhaust pipe between the engine and the condenser. No trouble was then caused by the oil in the condenser, and the separator was much simpler and more efficient than the filter used for removing oil from the water. The oil was separated from the exhaust steam by changing the direction and reducing the velocity of the steam, the action being similar to that of an ordinary steam separator.

Mr. Ruthven Murray said the author of the paper had told them that Poplar intended to drive surface condensers from high speed engines. They ran about the usual high speed, not the highest speed of all. He daresay they were aware that very often the centrifugal pump was connected directly with the shaft, and air pumps were driven by means of reducing gear. This was the arrangement Mr. Blackman had put in at Poplar. The gear was set at the back of the engine on the extension main shaft, and beyond that again came the circulating pump. He believed two or three makers of high speed engines had expressed approval of the idea and believed it would come greatly into use. The advantage in separate condensers was that they could always obtain their vacuum easily before they started the engine. This was important where they started the plant quickly. The elimination of oil was a difficult matter, and he fancied the process which Mr. Klein mentioned, but he heard the other day that some chemists in London had perfected a process, which was shortly going to be put on the market, by which oil was entirely eliminated from the water in some manner he did not at present know about. He was sure, if it came to anything, they would all be interested in it. It was said to be very cheap and very efficient. In the meantime, having looked at the question carefully, he had come to the conclusion that the best possible way, if they could spare the space, was to treat the condensed water in the same manner as they would if they were dealing with dirty water—put it through an ordinary sand-filter.

* Electrical Review, July 21st, 1899, p. 120.

Mr. Morley said he quite agreed that the best form of condensing plant was the surface condensing plant. As Mr. Wordingham had pointed out, it was possible to test each engine separately by the discharge of water from the engine into the condenser, provided there was no leakage on the water side. But the difficulty which arose in connection with condensing plant, as had been pointed out, was that the oil got into the water. He believed it was impossible at present to remove all the oil from the water, but when one had seen the condensed steam passed through a filter and eventually pumped into a boiler and used there without any disadvantage, one was led to believe that a slight amount of oil in the water was not always detrimental. Mr. Snell had pointed out that he had at his station engines running with very little oil. There were many marine engines running with no oil at all, and the only time it was used was when entering port, when a little oil was put in the cylinders to keep the parts from rusting. With regard to the lubrication of engines with graphite he must say it had not been successful. They had tried mixing graphite with the oil, but neither had been an advantage. It was difficult to compare the cost. Some stations would require a different length of pipe. The cost of surface condensing plant was often very much increased by the arrangement of pipes.

Mr. Mountain (Huddersfield) remarked that he could not agree with Mr. Snell in his wholesale condemnation of the jet condenser. If they took a lesson from some of the large cotton mills in Lancashire they would be able to get satisfactory results on exactly the same lines as they were doing. Dealing with the beginning of the paper, they would find that the temperature of the incoming water was exceedingly low and the temperature of the incoming steam was proportionately low. Therefore, if they got a high pressure, the results would be better than if they had to use an intermediate metal, which was losing heat. Speaking of marine experience, they were bound to use surface condensers on board a boat, because they could not use sea water. There they could not possibly use oil, otherwise it would get into the condenser, and they would be troubled with the boilers. In Huddersfield they tried the marine dodge, and ran for two years without oil; then they renewed the whole of their pistons and rings and started again on oil. Any engineer of large knowledge would tell them that oil, or a lubricant of some sort, was necessary. Graphite he had tried, and it was not all that could be desired; it got into the passages and bottoms of the cylinders and clogged up the spaces down there. Really it was not much use in its present form.

Mr. Quin (Blackpool) dealt with the question of the separation of oil from the condensed water. He said he had two classes of filter—one sand and coke and the other sawdust. He passed the condensed water through both. He did not know exactly to what extent it did take it out, but he knew there was plenty of oil on the far side of the condenser. A chemical process had been in use in some electrical chemical works in the Midlands which was said to be cheap and efficient, but so far as his experience of filters went, no make at present was cheap or efficient.

Mr. Andrews (Hastings) desired to thank Mr. Snell for bringing this interesting subject before them. At Hastings they had to pay about 9d. per 1,000 gallons of water, so that the ordinary surface condensing was out of the question. They had but little space for cooling towers, and their site appeared to be in a particularly advantageous position for evaporative condensers. Consequently, about two years ago they put up a vertical tube evaporative condenser. During the two years a great deal had been spent in altering that condenser, in order to obtain a satisfactory vacuum. In a recent discussion he pointed out that one of the chief improvements they had been enabled to introduce was the connection of the nests of tubes in series instead of parallel. Another improvement, he thought, was that they drained the condenser by gravity. They connected the bottom of the condensers with the hot well by one or two vertical air pipes, and the vacuum in the condensers sucked up a column of water, which constantly balanced itself. He quite agreed that the chief objection to evaporative condensers was that they were bound to put them on the roof some distance from the engine house. One of their earlier experiences was a vacuum of about 23 inches in the air pump, and about 24 inches in the engine, and now they got about 18 inches in the engine, and 20 in the air pump. The opinion they had arrived at at Hastings was—the larger the condenser, the less the vacuum. They got a better vacuum when working at full load than when working at one-tenth load. There was a difficulty with air leaks which, to his mind, was the only real difficulty in working evaporative condensers with success.

Mr. Fletcher (Ashton-under-Lyne) referred to steamers running without oil, and said he was told the reason of trouble in the cylinders was using a little oil. If they once used a little oil they had trouble. He had seen engines running apparently satisfactorily without oil.

Mr. Highfield (St. Helens) was not clear that the cooling tower system would get rid of the evils. The question of the cylinder lubrication depended mostly upon the quality of the steam put into the engine. No doubt, with wet steam, the cylinders would run fairly well without any lubrication at all, but with superheated steam it was different.

Mr. H. B. Spencer sounded a note of warning as regarded air and circulating pumps worked by the main engine. Some years ago, when he was with an engine insurance company in Manchester, he had occasion to analyse the various breakdowns of engines that had occurred over a considerable period. He found that about 20 per cent. of these were due to failures of air pumps or condensers. He thought that electrical engineers were much more free from accidents with their separate condensing plants than if they had had pumps worked even by slow speed main engines. The advantages of having the condensing plant independent of the main engine were now being recognised, and he might add that his father, Mr. John Fred. Spencer, who had had a good deal to do with the introduction of the surface condenser, had designed, some 30 years ago for Woolwich Arsenal, some independent surface condensers, two of which were working satisfactorily, and had advocated the use of such arrangements for large engines. He questioned whether it was worth while endeavouring to work engines without oil. Although now possible with saturated steam, there could be no question that in a few years' time most of the gentlemen present would be using superheated steam, and oil would then be a necessity. Some years ago he had had to do with an engine at Bristol which was finally worked without oil after several vain attempts had been made to remove oil from the condensed steam by filters. The boiler was of the West India type externally fired, and the entrance of oil into the boiler was immediately followed by softening of the plate over the furnace, thus it was absolutely necessary to exclude it. To enable the engine to work without oil a saddle was fitted over the slide valve on Messrs. Thornycroft's system. This arrangement was successful, but involved a good deal of attention. He believed that the oil difficulty was best solved by the means Mr. Klein had referred to, namely, by separator in the exhaust pipe, which had recently been found successful in several instances.

Mr. Taite (Southport) remarked that they had two jet condensers which worked satisfactorily. With regard to the cooling towers, they had lately been considering the question, and they decided in preference to construct a reservoir to hold about 1,000,000 gallons of water, which they estimated would be sufficient for their purpose. That reservoir, with the connecting pipes, had cost about £3,000, so that it worked out at a fairly low figure per horse-power.

Mr. Minshall (Croydon) referring to remarks made as to the use of graphite, said he had been informed that when torpedo boats were on their trial trips they used all the oil they could get hold of, and not graphite.

Mr. Sutherland (Worcester) said he had been specially interested in the portion of the paper referring to the circulation of water.

Mr. Snell, in replying upon the discussion, thanked his hearers for the way in which they had received the paper. As he had previously stated, there was nothing new in it, but it had proved a nucleus for an interesting and, he hoped, useful discussion. He was glad that an engineer of such vast experience as Mr. Chamen agreed with him on the question of condensers, but he had been surprised at the statement of Mr. Barnard as to the obtaining of a satisfactory result without using the water seal. He had since learnt that Mr. Rider was also running one without the water seal. His experiences of evaporative condensers had not been of a very pleasing kind, and he could hardly realise anyone going in for the old-fashioned jet condensers. As to the use of oil, he could only say that during the last 18 months they had been running without oil, except a flushing on Saturdays, just to prevent the rusting of the cylinders.

TELEGRAPH RATES TO THE EAST.

The following letter, to which reference was made on p. 169 of our last issue, was inadvertently omitted.—

To the Editor of the "Times."

Sir,—I beg leave to reply to the observations made by Lord Tweeddale at the annual meeting of the Eastern Telegraph Company. My intention is only to deal with that portion of his remarks which relates to the views of the deputation of members of the House of Commons Committee for the reduction of telegraph rates laid before the Chancellor of the Exchequer. For, Sir, the comments which you yourself make upon the whole tenor of the company's defence are so remarkably trenchant and incisive, that we do not consider it necessary to add anything to the statesmanlike view you take in the public interest.

Lord Tweeddale denounces my statements as inaccurate and irrelevant. This denunciation, as I hope to show, categorically, is based upon false premisses and gratuitous assumptions.

1. That I asserted that because the companies were subsidised, the tariff should be very much less. What I said was (and the shorthand report is before me), that their position was not altogether that of a private concern, because of these subsidies, and that the public were therefore entitled to claim the assistance of the Government in regard to obtaining lower tariffs, either by means of pressure on the companies, or by the adoption of alternative routes.

2. That I represented the amount of the Australian subvention as £42,000. What I did say was, in the hearing of the whole deputation, that the companies were in receipt of an amount of £32,000 yearly, to continue for 30 years, thus making, inclusive of a subsidy of £1,000,000 sterling from the Imperial Government, the very considerable sum of close upon £2,000,000 sterling.

3. That I stated the amount of dividend as having been 7 per cent. for a great many years past. What I did say was, that the dividend for nine years ending 1896-97 was 6½ per cent., and the subsequent two years 7 per cent. As throwing a flood of light upon the true inwardness of the real percentage represented by the dividends, I quoted from the report of the Pacific Cable Committee the following extract from the *Economist*:—

"But it must be remembered that these are rates payable on a watered capital, and that they represent considerably higher returns upon the money actually put into the cables. Thus the Eastern capital was watered to the amount of £819,500 and the Eastern Extension to the amount of £472,500, and a dividend of 6½ per cent. on the Eastern capital should read as 8¼ on the original capital, while 7 per cent. on the Eastern Extension capital means over 9 per cent. on the capital prior to its being watered. Beyond this, these com-

panies have worked themselves into a strong position by not dividing to the full extent profits legitimately earned. The dividends have been no guide to the profits made, and if requisite the tariffs would be reduced without affecting the payments to the shareholders."

4. That I vouched for the existence of a special reserve for the purpose of duplicating the cables. Well, Sir, I took the reserve funds of the Eastern and Eastern Extension, which, on the best possible information I was able to obtain, now stand at £2,137,000, at the lowest computation, and, deducting therefrom the 1½ million at the credit of the ordinary reserve funds, I treated the remainder as representing the special reserve which, by a consensus of opinion in mercantile circles, is assumed to be earmarked for the purpose to which I made reference. If this balance is not wholly sufficient, it is certainly an appreciable nucleus towards that purpose.

5. That I stated that business men of other countries have their messages carried at an enormously cheaper rate. This is perfectly true, but not in the sense in which he interprets it, because, Sir, I was endeavouring to call attention to the disadvantages under which our merchants are labouring, and I now quote *verbatim* from the shorthand report:—

"Our people were forestalled by the business men of other countries being enabled to compete owing to the enormously cheaper level of rates levied by the companies within their possessions. For instance, a Frenchman can send to Tunis or Algeria for ½d. per word; the Russian can send to most of his colonies, even as far as Vladivostok (6,000 miles), for 4d. per word, whereas the merchant in Great Britain pays no less than 4s. to India."

Then, Sir, turning to my statement in regard to the vulnerability of cable lines, Lord Tweeddale tries to rebut our conclusions by instancing the absence of injury to cables during the wars between Turkey and Greece and China and Japan. To demonstrate, Sir, the utter irrelevancy of this, I need but recall to his memory that neither of the defeated nations had at all a reasonably strong navy to attempt cutting cables, whereas in the instance I did mention—that of the war between Spain and America—both the combatants in virtue of the comparative strength of their respective navies, as illustrated by the stubbornness and duration of the struggle, were able to and did most effectually sever the cable in the sphere of their immediate operations.

6. Then, Sir, I drew attention to the glaring inequalities of the rates to the East. To that Lord Tweeddale replies that "it was because the tariffs were practically controlled by the European Governments." Now let us test this assertion. A word to Fao, at the head of the Persian Gulf, passing over German, Austrian, and Turkish Government lines—further, a word to Julfa, passing over German, Russian, or Turkish lines, are the one and the other charged "6½d.," but as soon as the private companies get hold of that word to transmit it further, the rate goes up by leaps and bounds. So that although the chairman's bare statement is literally correct, the inference he seeks to draw from it is fallacious, inasmuch as the European control he insists upon is towards cheapness; the moment that salutary control is withdrawn our troubles begin.

Sir, even an "irresponsible politician" has some notion of logic.

As regards the specially high rates to India upon which the deputation laid so much stress—a view which obtained the hearty concurrence of the Chancellor of the Exchequer—it must be a matter of satisfaction to know that the companies are now prepared to negotiate for a reduction. The public will have learned with still greater satisfaction the newly-born zeal of the companies to contribute to the promotion of telegraphic facilities as evidenced by their proposal to lay a new cable from South Africa to Australia—a proposal all the more meritorious as it is divested of all appeals for Government or extraneous support.

In conclusion, I may be allowed to offer the companies a word of congratulation on their expressed desire to second the efforts of the House of Commons Committee to obtain a full and searching inquiry by means of a Royal Commission, or its equivalent.

I remain, your obedient servant,

EDWARD SASSOON.

Hôtel Métropole, Folkestone, *July 21st*.

THE STANDARDISING OF LIGHT RAILWAYS.

MR. PAIN'S recent paper on this important question before the Engineering Conference did not, it is true, produce much discussion, but it has stirred up a letter from a Westminster engineer which does at least open out the peculiar bent of mind of denizens of that quarter. Writing to the *Engineer*, Mr. Shelford takes an entirely one-sided view of light railways. He can talk about nothing but locomotives, nor can he discuss the light railway, except in its co-relations with steam traction. He appears entirely to shut his eyes to the fact that the future of light railways is far more likely to be bound up in electric than in steam traction. From the subject of light railways, he next bounds off to that of bridges. That Westminster engineers have ruined English foreign-bridge business is pretty surely wrong, but they soon will unless they mend their ways and begin to learn what bridge work is. Mr. Shelford's remarks on this subject merely beg the question, and go a long way to show that the burden laid upon Westminster has not been undeserved. Mr. Shelford's letter is a plea for ringing the changes of design to the uttermost.

It is, perhaps, fortunate for Americans that their bridge builders have been the rolling mills themselves, or pretty closely affiliated thereto. Hence the practical solution they have arrived at whereby the mere consultant, with pupils to occupy on drawings, has not been able to spread himself so freely as he has done here. We do not wish to be understood as standing up for American bridge work. So far as it goes it is sound and good, though it is, perhaps, too finely cut in material. But in its cost per pound it is cheap, and it is an easy matter to secure an American bridge of greater strength by simply specifying for heavier loads. A bridge built for a load we may call 150 would be strong for a load of 100. It is the way they go to work, and the large number of uniform sections that they keep in stock, that enable American bridge builders to compete so successfully, and it is just in these points that Westminster engineers go so far astray.

Nor is it in bridge work alone. In all branches we find specifications issued from Westminster by men who may be perfectly sound in their knowledge of principles, that are a laughing stock to specialist engineers in construction who are equally well versed in principles. As we have before said, the duty of the consultant is to see that his client gets the best value in the market, and not to design things himself unless it is necessary. It is possible that this craze for new design arose from the time when Westminster was the home of the early railway engineers, who were really called on to design. All engineering dealing with the face of nature, such as the drainage of land, the training of rivers, the making of a dam across a valley, finds certain fixed environment, and the works must be specially designed to fit in with nature, and such articles as tunnels cannot be bought by the yard, and may probably form subjects of special design; not so the common brick which lines it nor the dynamo which lights it.

TRIP GEARS AND HIGH SPEED ENGINES

IN a recent communication to the *Mechanical Engineer*, Mr. Jas Dunlop criticises the abandonment of the wrist plate in trip gear for valves. All the earlier Corliss gears employed the wrist plate movement. Our author states that two of the oldest firms in the country as regards Corliss gear, still use the wrist plate. As most of our readers will know, the wrist plate is simply an oscillating disc worked by the eccentric, and carrying four pins, to which are attached the rods of the four valves. By suitable choice of the position of these pins upon the plate the relative angular movement of the virtual crank arms of the wrist plate and of the valves themselves can be so determined as to give very different movements of the valve crank arm and the wrist plate. In this way is introduced a period of waiting, and it is during the waiting period that engagement of the tripping edges must take place. In this way the speed of rotation of a trip gear engine may be made 30 per cent. faster than for an engine in which the wrist plate is not employed.

Our author enters fully into the question, dealing with the actual fraction of a second during which the trip gear must effect its engagement. As regards the mere question of trip engagement, a wrist plate will allow of double the rotative speed being attained that is possible without the plate, though in actual practice this cannot be said to hold good, as there enters into the question the noise and clatter of contact, and this reduces the speed of rotation which is possible apart from these items, which include shock on the contact edges, inertia and valve load due to unbalanced steam pressure. While fully appreciating all that Mr. Dunlop has to advance, we feel inclined to doubt the benefits of trip gear, and the virtue of an extremely square edge at cut-off.

The virtues of the Corliss valve as a mere cut-off valve were very loudly extolled, whereas the real virtue of the original valve lay in its effective cylinder drainage, the Corliss gear being usually applied to horizontal engines, with the exhaust valves below the cylinders. Practical engineers have learned to recognise the folly of carrying to an excessive length all such matters as expansion and superfine valve gears. They realise that most engines are rated at too low a power, that expansion, as aimed at, is still apt to be greater than economy demands. Only recently we found some engines to be very much more economical at loads very considerably above normal than at the rated load, and especially where maximum loading is a question of a few occasional moments only, do we find engines made too large. At the same time we fully agree with the author of the paper under review that the wrist plate motion has perhaps been too lightly abandoned by Corliss gear makers. This has been often done more for the sake of producing an original motion than to obtain any real benefit.

Rheostats.—We have received from the Ward Leonard Electric Company their catalogue of Carpenter enamel rheostats, containing information regarding 125 different standard forms, all of which are customarily carried in stock by the company. There have been large reductions made in the prices, brought about by improved methods of manufacture. The price is now only about the same as when they were first placed upon the market in 1892. The list is so arranged that a rheostat can be selected for almost any possible use on any commercial circuit, for while they are designed for use as field rheostats, the complete data given as to number of steps, ohms, ampere capacity, size, &c., enable one to pick out one suitable for use in connection with ventilating fans, organ blowers, centrifugal pumps, storage batteries, and all such special applications for continuous duty purposes.

THE WORKMEN'S COMPENSATION ACT: MEANING OF THE TERM WORKMAN.

A case which raises one of the most important and, at the same time, one of the most difficult points upon the construction of the Workmen's Compensation Act was heard on May 31st in the Rotherham County Court. When the Act first came into force employers and employed were alike solicitous to know who was entitled to the benefits which it conferred. It seems to have been hitherto taken for granted that its operation was confined to those injured while employed in actual manual labour, but according to the decision of the arbitrator in the Rotherham case who awarded damages to a colliery deputy, the term "workman" as used in the Act is capable of a wider and more comprehensive interpretation. The facts of the case, which are reported in another column of the present issue, are shortly as follows:—The plaintiff was the legal personal representative of Matthew Allott her husband, who had been employed as colliery deputy by the defendant company, and who was crushed to death on February 24th last. No dispute arose as to whether the accident occurred in the course of the employment, the important issue being whether the deceased man was properly included in the definition of the term "workman" as contained in the Act. By that definition every person who is engaged in employment, whether by way of "manual labour or otherwise," comes within the scope of the Act. For the dependents of the deceased, it was urged that the words "or otherwise" made the Act apply. The nature of Allott's employment may be gathered from the evidence which was given by the witnesses:—He had a standing wage of 35s. a week. He had absolute authority when the manager was not present. He had no manual labour of any kind. In cross-examination, however, it was elicited that the deceased sometimes stirred up the fires of the ventilating furnace, and that he had also lit the fires on a Sunday. At the conclusion of the evidence the arbitrator said:—"The manager of one of our large steel works would not be a workman." After a lengthy argument by the counsel engaged, in the course of which reference was made to cases decided under the Employers' Liability Act, judgment was given in favour of the applicant. The arbitrator said:—"We must take it, generally speaking, that Allott was a man who worked, and that the chief portion of his work was manual and not mental labour. For 14 years Allott had worked as a deputy in the mine, and from the special rules, it appeared that he was a person who had the superintendence of others, and had certain responsibilities in addition, but so far as the special rules were concerned, he was not engaged in actual handicraftsman's work. The real crux of the question is the definition of workman, and I take it that the term "manual labour" is a general expression, and that "or otherwise" means something different from it.

With great respect to the learned arbitrator, it is submitted that this decision is erroneous, and contrary to the rules of construction which are invariably applied to the interpretation of statutes. The doctrine of *ejusdem generis* is well known and was apparently intended to meet cases of this kind. According to that doctrine, where a narrow expression is followed by one which is more general, the latter is to be interpreted in the light of the former. Once depart from this rule, and we have the result which is prophesied by Mr. Ruegg, Q.C., a learned commentator on the Act, who says in his book: "We see no reason why the architect of a building of the kind included in the Act, or the surveyor of an 'engineering work' should not recover compensation from the undertaker, if injured whilst engaged upon the works. Such person could be said to be engaged in the employment, although the contract between him and the undertaker was not a contract of service, but, in the words of the Act, 'an agreement made otherwise.'" Mr. Beven, in his work on the Compensation Act, does not agree with this principle, and with great deference to the better judgment of the commentator who has propounded it, we are inclined to agree with him. By an ancient rule of construction, *verba generalia restringuntur ad habilitatem rei vel personae*. This has been translated by Lord Bacon to mean "that all words, whether in deeds or statutes or otherwise, if they be general, and not express and precise, shall be restrained into the fitness of the matter or person." In Gordon *v.* Jennings (9 Q. B. D. 45) a point of a somewhat similar kind was discussed by the Court. By the Wages Attachment Abolition Act of 1870, it is enacted that after the passing of the Act no order for the attachment of the wages of any servant, labourer or workman, shall be made by the judge of any court of record or inferior court. An attachment had been issued against a judgment debtor who was employed as secretary to a company. It was his duty to attend at their office daily, to keep their accounts, and generally perform the duties of a secretary. His salary was £200 a year. The judge at Chambers had dismissed the case on the ground that the defendant was not a "servant" within the meaning of the Act, and in this he was upheld by Grove and Lopes, J. J. Grove, J., said:—We must construe this word "servant" as used in this Act, having regard to the subject matter and the intention of the Act, and also its collocation with other words. In one sense a Secretary of State is a servant, but obviously the statute cannot be meant to apply to every person who may be called a servant in any sense of the term. The intention of the Act is to abolish the attachment of wages. . . . . Taking the collocation of the word "servant" with "workman" and "labourer," it is obvious that the reasonable application of the Act is to persons of small means—to servants such as labourers and workmen receiving small wages at short periods. . . . . No doubt cases might arise in which it would be difficult to draw the line, but I am clearly of opinion that this case is not within the Act.

By a parity of reasoning, the manager of a mine may well be excluded from the operation of the Workmen's Compensation Act. The whole tenor of the Act, the reasons which caused it to be brought before Parliament in the first instance, and the scale upon which the payment of compensation is founded, all point to its being confined to the working classes. Payment of £300 would in no sense compensate the superintendent for the loss of his sight, nor would the modest weekly award provide for the wants of a highly salaried manager.

In the Employers and Workmen Act, 1875, the expression "workman" does not include domestic or menial servants, but means any person who, being a labourer, servant in husbandry, journeyman, artificer, handicraftsman, miner, or otherwise engaged in manual labour, whether under the age of 21 or above that age, has entered into or works under a contract with an employer, whether the contract be made before or after the passing of this Act, be expressed or implied, oral or in writing, and be a contract of service or a contract personally to execute any work or labour. Had this definition been incorporated with the Workmen's Compensation Act much difficulty would have been saved.

Moreover—to return to the case from Rotherham—it would seem that the decision of the arbitrator is illogical on the face of it, for he himself admitted that the manager of one of our great steel factories did not come within the operation of the Act, and he expressly found that the labours of the deputy "were not those of a handicraftsman." It is hoped that this point, which is admittedly one of a considerable difficulty, may shortly come before the judges *in banc* for satisfactory determination.

PINIONS FOR ELECTRIC MOTORS.

By E. KILBURN SCOTT.

An interesting development of the tramcar motor is the number of small businesses which have sprung up in the United States for the supply of its various accessories. For example, it has for some considerable time been possible to buy a commutator complete, or a new set of commutator segments without going to the manufacturer of the motor. One firm makes a speciality of the brush-holders and carbon brushes. Another sells the suspension springs, whilst the gearing may be bought direct from the wheel makers to suit any motor on the market.

At an early date in the history of electric traction it was

recognised that it would be to the general advantage to standardise the gear wheels, and the result has been that the following specification will suit practically any single reduction tramcar motor now in use :—

Specification of Standard 4·78 to 1 Single Reduction Gear for Tramcar Motors.

Solid Steel Pinion :—
Number of teeth, 14.
Pitch diameter of pinion, 4⅜ inches.
Outside diameter over teeth, 5⅓ inches.
Face of teeth, 4½ inches.
Bore to be tapered, $2\frac{5}{16}$ at wide end. Standard taper 1¼ inches per one foot.
Keyway, ¼ inch deep, ½ inch wide.
The teeth to be either pressed out hot or cut in a milling machine and polished.

Split cast-iron wheel, four arms :—
Number of teeth, 67.
Pitch diameter of wheel, 22½ inches.
Outside diameter over teeth, 23 inches.
Face of teeth, 4½ inches.
Boss of wheel, 6 inches diameter, 6¾ inches long.
Standard bore, 3⅜, 3¾, or 4 inches parallel.
Keyway, $\frac{7}{16}$ inch diameter, ·747 inch wide.
Wheel cast in halves accurately machined and bolted together. Teeth machine cut.

The design of the teeth to be involute or epicycloidal, and the efficiency of the gear to be not less than 95 per cent. when new.
Net price of the pinion, 15s. to 20s.
Net price of the cast-iron wheel, 36s. to 45s.

The large wheel is sometimes made of cast-steel, but the best results are given by best grey cast-iron. The quality of the steel used for the pinion, however, varies a good deal. Roughly speaking, the higher the percentage of carbon, the harder and more durable is the steel; but on the other hand, milling out teeth in high carbon steel is exceedingly expensive. The United States Projectile Company (whose agents in this country are Messrs. Laing, Wharton & Down, of New Bond Street, W.) have solved the problem by pressing heated steel through a glass hard die, and thus forming all the teeth at one operation. The pressure exerted is about 500 tons, and the result is that the pinion is very close grained and tough, whilst the hard skin given by the drawing process naturally tends towards a longer life. A specially high quality of steel is employed, having as much as ·3 per cent. of carbon in it, which is about double what could be used were the teeth to be milled out from the solid.

Those who have had anything to do with the application of electric motors to hauling drums, pumps, machine tools, &c., where toothed gearing is absolutely necessary, know how much depends on the satisfactory working of the first motion wheels, and especially on the pinion. All kinds of materials have been used for motor pinions, including phosphor bronze, raw hide, fibre interleaved with sheet steel plates, &c., but there is only one really satisfactory way of dealing with the matter, and that is, to employ a pinion made of hard steel, with accurately shaped straight teeth. Wherever possible, the speed of the motor should be brought down to admit of pinions having the following minimum diameters and widths, and say not less than 13 teeth :—

B.H.P. of motor.	Suggested speed.	Diameter at pitch circle.	Face of teeth.	Suggested minimum number of teeth.
3	680	3½	3½	13
5	630	4	4	13
7½	580	4	4	13
10	550	4	4	13
15	500	$4\frac{3}{16}$	4½	14
20	470	$4\frac{3}{16}$	4½	14
25	450	$4\frac{3}{16}$	4½	14
30	420	5¼	5	15
35	400	5¼	5	15
40	370	6¼	$5\frac{3}{4}$	17
50	350	8½	6½	19

Where there has been trouble with a motor driving a machine by gear wheels, it has nearly always been traceable to running the motor at a high speed, and having too small a pinion, or else using wheels with roughly cast or improperly shaped teeth. For example, the writer has heard of a wheel being ordered from one firm and the pinion from another without any regard to the contour of the teeth being struck out with the same rolling pitch circle; no wonder such gearing made a noise.

Double helical teeth are sometimes insisted on for motors of so small an output as 10 and 15 B.H.P., but this is a mistake, as the teeth must of necessity be roughly cast (machine-cut double helical teeth are not yet commercially possible), and the vees of the teeth are apt to vary to one side or the other. To remedy this, motor pinions have been so fitted that they could slide laterally on two feather keys, but the feathers soon wear loose, and the shock on the armature from this cause neutralises any improvement given by employing -shaped instead of straight teeth. Strengthening teeth by shrouding is a mistake in high speed gears, as what is principally wanted is plenty of wearing surface, and in increasing the width of the wheel to get this surface, all the required strength is obtained.

The ordinary rules of gear design have been modified a good deal by the successful application of electric power, but in reducing the speed of any motor, the writer would suggest that the following broad rules should be followed :—

(*a*) Keep the speed of the motor as low as possible ; two trains of wheels, each four or five to one reduction is the most that should be allowed, and in many cases it will pay to spend more on the motor, and have only single reduction.

(*b*) Employ straight teeth on the first pinion and wheel in all cases, the pinion of hard steel and the wheel of cast-iron.

(*c*) Have the teeth struck out with the same rolling pitch circles, the number of teeth in the pinion to be never less than 13.

(*d*) Fix the pinion rigidly on the motor shaft, which should by preference be tapered so that the pinion can be quickly replaced.

Where it is at all possible the writer would recommend that a standard traction motor gear, as specified above, with pressed steel pinion, should be used. These wheels are turned out in such quantities that it would pay to employ them for motors of only 10 or 15 B.H.P., although experience shows that at their standard speed they are strong enough to transmit 40 H.P. on an emergency.

INDISPENSABLE ACCESSORIES OF ELECTRIC TRACTION.

By HENRY E. P. COTTRELL, A.M.I.C.E.

(*Continued from page* 91.)

For heating purposes the coils used are similar to resistance coils, but they have to be entirely free from tension or strain and to be so suspended that in the event of accidental fracture they are held in place and the production of a short circuit is impossible. This is effected by supporting the coils on an asbestos cord passing through their entire length, drawn tight and fastened to the terminal insulators, and in this way the coils can be placed quite close to each

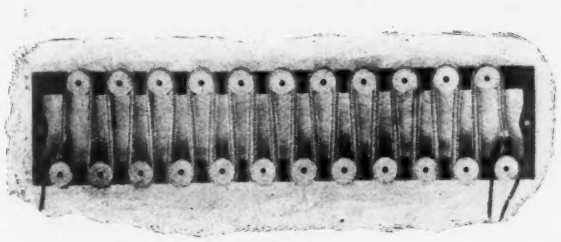


Fig. 53.—Coils.

other without fear of accident. The coils themselves are firmly fastened to the terminal insulators at each end, and the leading out wires are soldered firmly to the coil. The wire is of a special grade of steel which does not alter in resistance with use and is uniform throughout, so that liability to any local increase of temperature and consequent rapid local oxidation and the resulting destruction of the coil, due to slight flaws or imperfections, is reduced to a minimum. The frame is made of light steel carrying on

steel studs the porcelain insulators, over which the coils are passed, as will be seen by the accompanying fig. 53. The dimensions run from 17 inches to 28 inches in length, 10½ inches to 8 inches in height, and 2 inches to 3 inches wide, weighing only a few pounds, so that conditions 1, 3 and 5 are satisfied. The distribution of the heat is effected in such a way that the principal radiation is from the front surface, so that the loss which would be incurred by fixing the back against the side or floor of the car were the radiation uniform on both sides is avoided. The manipulation is effected by double-break single-pole switches (fig. 54),

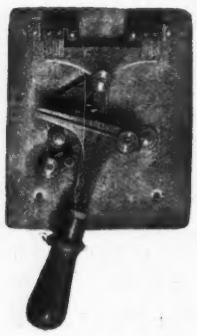


Fig. 54.—No. 1 Switch.

the full throw of the lever being completed immediately on being released, so that there can be no arcing and destruction of the jaws. These switches are made for single circuits and single heats, or for several circuits and any desired number of heats. The variation in heat is effected by having three or more different adjustments of resistance in the coils of each heater, using 3, 5, or 8, &c., amperes as required. If three divisions of heat production alone are used, then the heaters can be operated by a pair of single switches, if more than a pole-circuit or combination switch

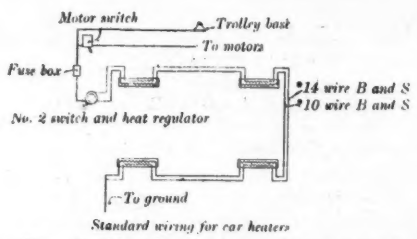


Fig. 55A.—Plan of wiring Four-heater equipment, one No. 2 switch. Three divisions of heat.

is required, the high resistance circuit takes 3 amperes and the low 5 amperes, the latter when operated alone giving the second degree of heat, and the maximum when the two circuits are in parallel; in all cases the manipulation

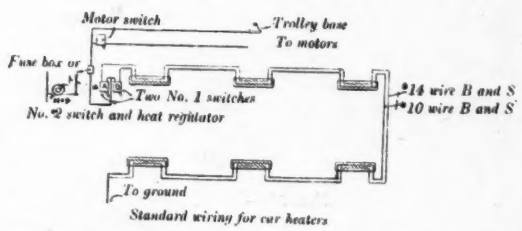


Fig. 55B.—A on, B off = low heat. B on, A off = medium heat. A and B on = full heat. Plan of wiring for Six-heater equipment using two No. 1 switches, or controlled by No. 2 Combination switch. Three divisions of heat.

is most simple, and any degree of heat can be obtained, so that conditions 2 and 4 are completely complied with. The following three plans for a four-heater, six-heater, and twelve-heater wiring respectively, show the way in which the electric heaters are applied in practice to various forms of car (figs. 55A, 55B, 55C.)

With the system of wiring shown above and the coils constructed as described, the cut-out in the circuit is rarely called into operation. Those generally used in connection

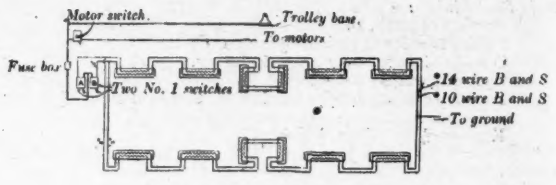


Fig. 55C.—A on, B off = low heat. B on, A off = medium heat. A and B on = full heat. Plan of wiring for Twelve-heater equipment. Three heats controlled by two No. 1 switches.

with a heating installation are perpetual cut-outs not subject to injury however often called into operation, so that burnt terminals and destroyed receptacles become a practical impossibility. The necessity for the use of costly automagnetic cut-outs or the unsatisfactory fusible variety is thus avoided. The use of two mono-current switches admits of the simplest form of wiring.

The following table gives the various types of heater in use, with dimensions and style of car to which they are adapted:—

Heater type.	Dimensions. Length.	Height.	Width.	Used. Fixed to	Type of car.	Remarks.
	in.	in.	in.			
A	27	10	2	Floor under seats.	Longitudinal seats open underneath.	For 16 to 20-foot cars, four heaters of any kind, except types E and C are required, and of these, six.
B	27	10	2	Riser panel on side of car.	Longitudinal seats closed underneath.	
C	22	8	2	Floor or suspended from seat.	Cross seat cars (short).	For 22 to 26 foot cars, six of the former and eight of the latter.
D	33½	8	2	Do. do.	Longitudinal seats open underneath.	A maximum current capacity of 1,000 watts is allowed in American practice for all varieties except E and C, but in Great Britain a maximum capacity of 800 would be sufficient.
E	17	10½	2	Do. do.	Cross seated cars (long).	
F	28	9	3	Panels.	Longitudinal seats closed underneath.	

Figs. 56, 57, and 58 illustrate the A, B, and F types of heater; types C, D, and E being similar to type A in appear-

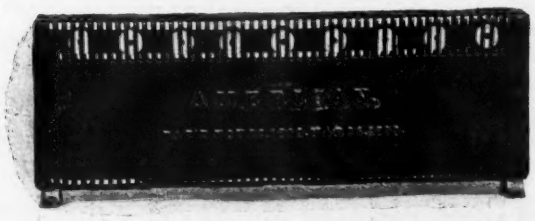


Fig. 56.—"A" Type.

ance. The author is indebted for the information from which the above is compiled to Messrs. R. W. Blackwell and Co.

Lighting.

There can be no question that just as the only reasonable and satisfactory way of heating an electric car is by using

the current for that purpose, so also the only reasonable and satisfactory way of lighting it is also by using the current. On no properly installed electric tramway need there now be

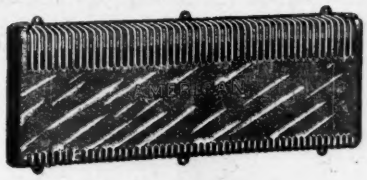


Fig. 57.—"B" Type.

any fear of a sudden drop of voltage, such as would cause an interruption in the light which the cars require both for safety and convenience. In the older installations this was

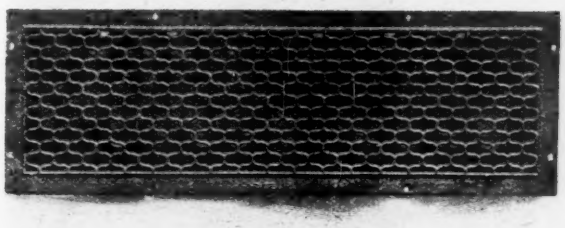
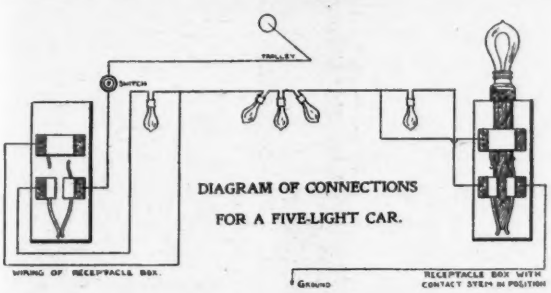
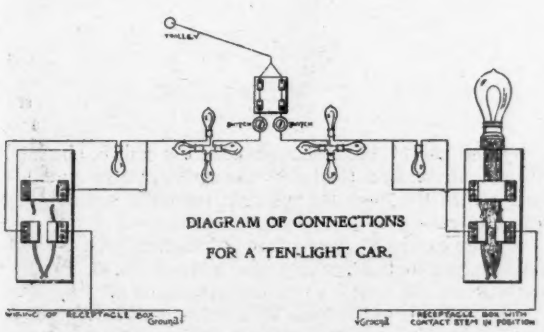


Fig. 58.—"F" Panel Type.

by no means always the case, and the sudden drop in the efficiency of the lights following immediately on starting often made passengers regret their more steady, if less brilliant, petroleum predecessors. These little mischances, however, may be taken as once and for all, removed from the most approved modern working, and this being the case no one will question the superior convenience and merit of electric lighting for all car purposes as compared with any other form of lighting. In point of cleanliness, simplicity, ease of up-keep, and efficiency, the best forms of electric lighting for cars leave nothing to be desired. The two diagrams (figs. 59A and 59B), attached show the method





Figs. 59A and 59B.

of connecting the lights for a 5 and 10-light car respectively, exclusive of the head and tail lights which are additional in every case. Head lights, where the illuminant is oil, are notoriously troublesome as they get very hot, and, when handled in shifting from one end of the car to the other at the termini of the journey, get seriously knocked about on this account. They require constant repairs, their tanks are generally leaky, the smell is offensive, the reflectors are liable to be ruined by the oil, and they are perpetually dim, while the most serious of all, they are always more or less liable to being blown out by the wind. Their cost is also relatively high, as the following very moderate estimate will show :—

Oil per day (say)	1½d.
Chimneys and wicks, do....	0½d.
Cleaning, filling and trimming (men's time)	1½d.
Repairs	0½d.
	3½d.

= for 365 days to £4 18s. 10½d.

Against which has to be set the cost of repairs to the electric head light, which is a mere fraction of that for oil lights and the renewal of the time-expired filaments, the whole of which could easily be covered by an expenditure of about £3 10s. per annum, so that in little more than a year the cost of electric head lights could be recouped from the saving effected in maintenance, renewals and repairs of the old oil head lights. The importance of having brilliant and dependable head lights cannot be too strongly insisted upon, especially on electric cars moving swiftly and comparatively noiselessly through the streets, and, if in addition to this, an actual saving is effected by the use of electricity as an illuminant, there can be no question that they are indispensable accessories of electric traction. Fig. 60 shows one of the most

Fig. 60.

convenient forms in use. This is known as the Syracuse changeable electric head light. The chief merit of this form of lamp consists in the ease and rapidity with which it can be shifted from one end of the car to the other and exchanged for the coloured tail light by the motorman and conductor when they change ends at the terminus. Fig. 61 shows the change in progress. In this head light the parabolic reflector is of 99 per cent. pure aluminium encased in steel jacket (22 B.W.G.) with a handle at top, and a 12-inch glass front fitted in a nickel plated solid brass rim with hinge and catch. The lantern is fixed on the top of a waterproofed hickory contact stem with brass contact plates communicating with the lampholder. Cast-iron receptacles 10 inches high and 4 inches wide with square sockets of the dimensions of the contact stem containing brass spring connections, are fixed to the two dash-

boards at the car ends, and connected with the light circuit in the car, as shown in fig. 62. When the contact stem is inserted in the socket the circuit is complete, and the light,

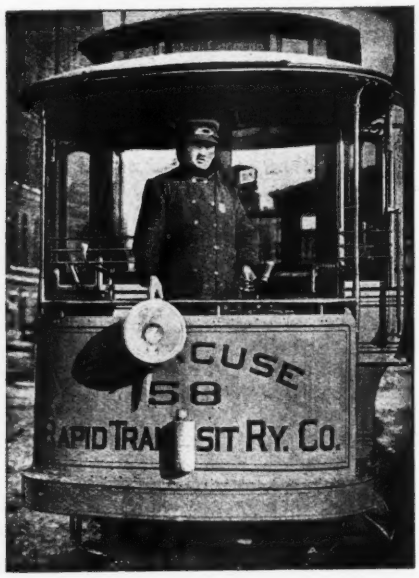
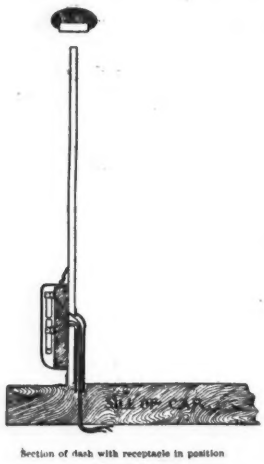


Fig. 61.

if the current is switched on, at once appears. All these head lights are interchangeable, and can be shifted from one car to another if required, as they fit all holders. The same



Section of dash with receptacle in position

Fig. 62.

proportionate economy can be effected in the substitution of incandescent lights for ordinary oil lamps throughout the car interior and in the tail lights.

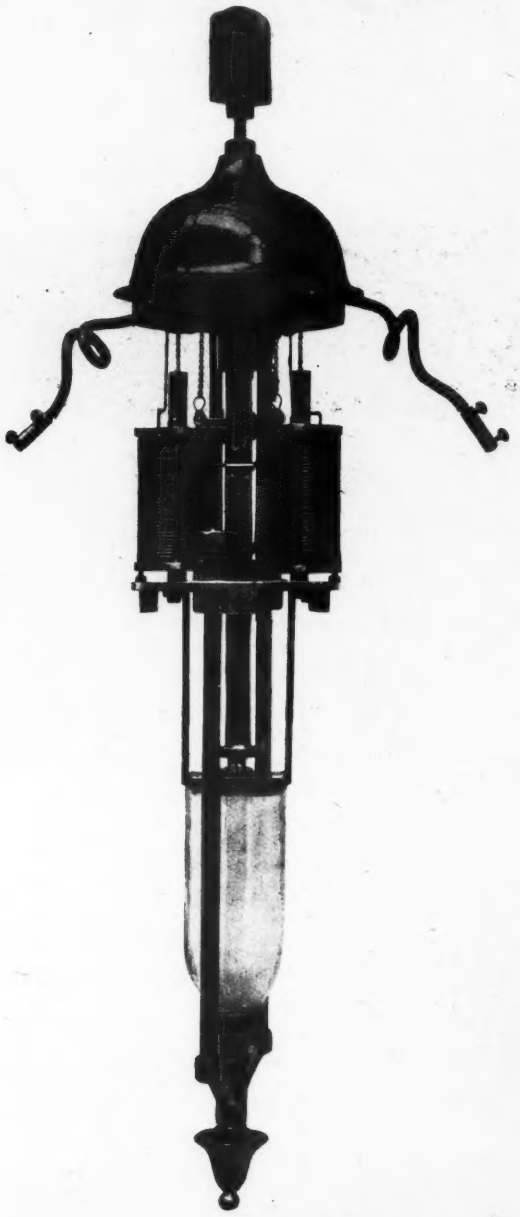
(To be continued.)

THE "JAMES" ENCLOSED ARC LAMP.

Simplicity and strength are two of the first essentials of an enclosed arc lamp which is to run satisfactorily, and both of these essentials are to be found in the lamp before us.

Realising that a lamp has to stand a considerable amount of rough usage, often at inexperienced hands, the manufacturers have turned out a lamp which will stand rough handling without getting seriously out of alignment, a fatal defect in some lamps, enclosed and otherwise, which we have seen. The top and bottom plates are solid brass castings, and the rods are solid to allow of a deep-cut screw thread, the result being that the lamp can be rested on end or at an angle without fear of any part bending or distorting.

The corona and cap are copper spinnings, and the corona can be easily removed (by taking out two screws) to get at the mechanism should necessity arise.



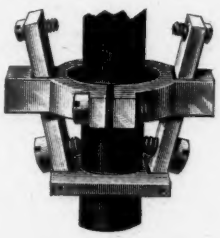
By the use of two balanced coils the pull is absolutely straight throughout the lift of the carbon, the dashpot is in dead centre line, and the plunger carries a simple single acting valve.

The top carbon fits into a conical carbon holder, having ample spring contacts, within the centre tube, on the lower end of which the clutch, which we illustrate on p. 215, is fixed.

This clutch is in the form of a split-ring binding on the centre tube with a single screw, and consists of two arms hinged on a lower ring carrying two adjustable screws to grip, and allow for, carbons of slight variation in diameter, and the lift being absolutely vertical, the probability of jamming is reduced to a minimum.

In the event of a carbon breaking in the tube the clutch can be easily removed to permit the removal of the holder and can be as readily replaced in perfect adjustment.

There is an entire absence of springs or of material that can be injured by heat. Our illustration shows a lamp for single parallel, but for series circuits a shunt coil is added and fixed to one of the stays, and the core is carried from an arm attached to the centre tube yoke immediately above the



coils, in no way altering the general construction of the lamp. When required, a special form of automatic cut-out may be added.

There is room in the cap for impedance coils and resistances if required to be so fitted. The lamp runs very steadily and the feed is almost imperceptible.

We understand that two of these lamps have been running satisfactorily in series on 220 volts at a frequency of 40.

In general appearance the lamp is neat, ventilation is duly provided for, and altogether we can congratulate Messrs. James & Mills on the result of their efforts.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS. 1899.

mpiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool; Manchester, and Birmingham, to whom all inquiries should be addressed.

6,125A. "Improvements in and relating to secondary batteries." P. M. JUSTICE. (The Pope Manufacturing Company, United States.) Dated July 20th. (Date claimed under patents rule 19, March 21st, 1899.) (Complete.)

14,668. "Improvements in and connected with movable electric lights." H. O. FARRELL. Dated July 17th.

14,687. "Electro-magnetic brake." P. F. L. R. H. K. VOIGT and W. C. KUSTERER. Dated July 17th. (Complete.)

14,703. "Improvements relating to carbon electrodes for arc lamps." H. BREMER. Dated July 17th.

14,704. "Improvements in electrodes for electric arc lamps." H. BREMER. Dated July 17th.

14,734. "An improved auto copying telegraph." A. C. BROWN and R. BURN. Dated July 18th.

14,736. "An improved winding for dynamos." M. H. HURRELL. Dated July 18th.

14,774. "Improvements in or relating to submarine electric arc lamps." F. G. HALL, jun., and I. E. BURDICK. Dated July 18th. (Complete.)

14,789. "Improvements in electrical locking apparatus for railway signals." G. H. JELFS. Dated July 18th. (Complete.)

14,794. "Improvements in and relating to storage batteries." S. Y. HEEBNER. Dated July 18th. (Complete.)

14,806. "Improved counter or meter for electric lamps, motors, and other electric apparatus." G. DI P. MAGINI. Dated July 18th.

14,826. "Improvements in or connected with apparatus for use in the production of Röntgen rays." W. P. THOMPSON. (The Voltohm-Elektrizitäts-Gesellschaft, A. G., Germany.) Dated July 18th.

14,859. "Automatic electric signalling apparatus for pneumatic dispatch tubes." T. STACEY. Dated July 19th.

14,877. "Sound-proof telephone cabinet." H. P. J. WULFF and J. H. BLUNCK. Dated July 19th. (Complete.)

14,878. "Improvements in covering electrical and other wires and apparatus therefor." W. W. COLLEY. Dated July 19th.

14,892. "Improvements in automatic electric signs." J. D. F. ANDREWS. Dated July 19th.

14,906. "Improvements in fuse blocks for electric circuits." H. P. DAVIS. Dated July 19th. (Date applied for under Patents, &c., Act, 1883, Section 103, January 30th, 1899, being date of application in United States.)

14,907. "Improvements in circuit breakers." H. P. DAVIS and G. WRIGHT. Dated July 19th. (Date applied for under Patents, &c., Act, 1883, Section 103, March 23rd, 1899, being date of application in United States.)

14,908. "Improvements relating to the distribution of electrical power." R. D. MERSHON. Dated July 19th. (Date applied for under Patents, &c., Act, 1883, Section 103, February 1st, 1899, being date of application in United States.)

14,909. "Improvements in dynamo-electric machines." B. G. LAMME. Dated July 19th. (Date applied for under Patents, &c., Act, 1883, Section 103, April 14th, 1899, being date of application in United States.)

14,943. "An improvement relating to the bearing of dynamos and other machines." W. J. LISTER and E. J. S. WHEATCROFT. Dated July 20th.

14,946. "Improvements in or relating to electric meters." J. H. BARKER and J. A. EWING. Dated July 20th.

14,966. "The automatic electro-dynamatic ventilator." H. A. F. HAND. Dated July 20th.

14,973. "An improvement in electrical glow lamps." E. STERNE. Dated July 20th.

14,981. "Means for intercepting vagrant earth currents in electrical traction." W. CRAMER. Dated July 20th.

14,997. "Improvements in switches for electric circuits." G. WRIGHT and C. AALBORG. Dated July 20th. (Date applied for under Patents, &c., Act, 1883, Section 103, January 30th, 1899, being date of application in United States.)

14,998. "Improvements in fuse blocks for electric circuits." H. P. DAVIS. Dated July 20th. (Date applied for under Patents, &c., Act, 1883, Section 103, March 23rd, 1899, being date of application in United States.)

15,002. "Improvements in electric arc lamps." J. B. BARTON and THE JANDUS ARC LAMP AND ELECTRIC CO., LTD. Dated July 20th.

15,017. "Improvements in electric accumulators or secondary batteries." H. WEYMERSCH. Dated July 21st.

15,019. "Improvements in and relating to telephone switches and switch-boards." G. GILLMORE. Dated July 21st.

15,006. "Improvements in systems of electrical distribution." B. G. LAMME. Dated July 21st. (Date applied for under Patents, &c., Act, 1883, Section 103, January 30th, 1899, being date of application in United States.)

15,073. "A new method of manipulating ether waves for wireless electric or electro-magnetic telegraphy." J. LAISTER. Dated July 21st.

15,128. "Improvements relating to plug contacts or contact plugs for electric circuits." O. D. LUCAS. Dated July 22nd.

15,135. "Improvements in electrical clock arrangements and apparatus." F. T. HOLLINS and F. W. LEAK. Dated July 22nd.

15,138. "Improvements in electrical machines." B. G. LAMME and J. P. MALLETT. Dated July 22nd. (Date applied for under Patents, &c., Act, 1883, Sec. 103, February 6th, 1899, being date of application in United States.)

15,139. "Improvements in automatic circuit breakers." G. WRIGHT and C. AALBORG. Dated July 22nd. (Date applied for under Patents, &c., Act, 1883, Sec. 103, March 23rd, 1899, being date of application in United States.)

15,143. "An alternative electric bell and telephone system." G. E. O. POLLAND. Dated July 22nd.

15,147. "Electrical apparatus for indicating the names of stations in railway and tramway vehicles." SIEMENS BROS. & CO., LIMITED. (Siemens & Halske, Aktien Gesellschaft, Germany.) Dated July 22nd. (Complete.)

15,148. "Improvements in junction boxes for underground electric conductors." SIEMENS BROS. & CO., LIMITED. (Siemens & Halske, Aktien Gesellschaft, Germany.) Dated July 22nd. (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 323, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

10,994. "Improvements in electric arc lamps." F. S. Worsley. Dated May 3rd, 1897. Arc lamps.—Brake mechanisms for striking and feeding are constructed as follows:—A lever is fitted co-axially or nearly so with a brake-wheel, the rim of which is grooved circularly. The lever carries a box containing two rollers, which support a wedge-shaped brake block, padded with rubber, against the rim of the brake wheel. The wheel thus moves with the lever, unless the latter is turned so that the wedge bears on a fixed stop. The lever may be connected with the core of a shunt solenoid or other controlling device, and the brake wheel is geared to the movable carbon or carbons. Other forms of brake block may be used. In a modification, the brake wheel is channelled circularly to receive two brake blocks, hinged together and hung by a wire from a bent support. A pin projects laterally from the lever between the blocks. The brake may otherwise act directly on a carbon holding rod, the wheel being dispensed with. 3 claims.

10,995. "Improvements in carbon holders for electric arc lamps." F. S. Worsley. Dated May 3rd, 1897. Arc lamp.—In order to secure carbons of various sizes in a circular or other socket made for a large carbon, bushes of suitable bores are fitted therein and secured by screws. The bushes are slotted to pass the screw by which the carbon is clamped. Small bushes may fit concentrically in larger ones. 2 claims.

11,017. "Improvements in telegraph cables or the like." J. J. Hall. Dated May 3rd, 1897. Cables formed of bundles of conductors enclosed in a lead sheath. Each conductor is enclosed in a loose layer of leno, muslin, or other netted fabric, held in position by a cord. 3 claims.

11,110. "Improvements in telegraphic apparatus." C. F. Eaton. Dated May 4th, 1897. Consists of a system of telegraphy in which the transmissions sent from a perforated strip are visibly shown or photographically recorded at the receiving station. The message is perforated in a strip and passed over a cylinder upon which ride a number of contact fingers corresponding to the allotted number of signals. The fingers are connected to contact points on the outer ring of a distributer, the arm of which is mounted on the shaft of the motor. The cylinder is moved one step by a ratchet and pawl for each revolution of the shaft. The contacts are grouped to radially correspond with insulating spaces on the middle ring of the distributer, whilst the inner ring is uninterrupted, and is connected to the line. The middle ring is connected to the shunt, including the magnet, and the outer ring is connected through the cylinder and shutter coil to the dynamo. The magnet operates a commutator for putting the battery in either direction to the field coils of the motor. The receiving apparatus consists of a disc mounted on a shaft and having a number of perforations corresponding in form to the signs transmitted. These pass in order in front of an opening in the end of an optical shutter, which, when open, allows the signs to be seen or to be recorded photographically on a sensitive surface, which is rotated similarly to the cylinder. The optical shutter consists of a tube containing two polarising prisms, set at right angles, and having between them a tube containing a liquid such as carbon bisulphide. The coil surrounds this tube. Beyond the tube is a source of light which on the receipt of a signal can pass through and either show or record such signal. Dynamos or transformers are arranged in series in the line so as to produce currents of sufficiently high potential for actuating the apparatus. 4 claims.

11,124. "Improvements in electric lampholders." E. L. Joseph. Dated May 4th, 1897. Incandescent lamps.—Holders for bayonet-capped lamps are provided with porcelain or other insulators, fitting loosely in them and on the contact plunger sockets. In a modification the insulator also covers the screw portions of the sockets, the plungers only being uncovered. The insulator may be in two or more parts. 2 claims.

14,254. "Improvements in or relating to ampere-hours electric meters." G. Hummel. Dated June 11th, 1897. Relates to quantity meters for continuous currents.—A coil is suspended between the pole pieces of a permanent or constant electro-magnet and connected by a reversing switch with the ends of a resistance carrying the main current. Thus resistance is made of a material having a low temperature resistance coefficient. The reversals of the shunt current cause the coil to oscillate. The oscillations are limited by a short arm on the coil touching either of two fixed springs, such contact short circuiting one or other of two electro-magnets, which are connected in series between the two main conductors. These magnets act on an armature carrying the movable part of the reversing switch, which remains in the position where either magnet places it until this magnet is short-circuited. The coil surrounds a conducting cylinder which is retarded by moving in the gaps between the magnet and an iron core. Iron pins on the pole pieces act on an iron cross piece, or an electro-magnet supplied with reversing current on the axle to assist the motion of the coil at the end of its oscillations. The movements of the axle or the reversing switch are communicated to a counter. The coil and damping cylinder are of copper or other material having a large temperature resistance coefficient, in order that the variation of the shunt current in the coil may compensate for the variation of the damping, owing to changes of temperature. 4 claims.

14,272. "Improvements in compositions containing casein for electric insulating and other purposes." P. H. Hansen and J. K. Westengaard. Dated June 11th, 1897. Compositions are formed of casein worked up with India-rubber dissolved in benzol and asphalt. Colouring matter, ground bone, kaolin, gypsum, and graphite may be added. The casein may be prepared by kneading milk curds or cheese in hot water, or by the process described in specification No. 1,550, A.D. 1897. The material can be used as a substitute for ebonite, &c., or as an electric insulating composition. 1 claim.

17,061. "Improvements in and connected with electrical furnaces." W. H. Monk. Dated July 20th, 1897. In an arc or incandescence furnace, the arc, or the current traversing a fused mass, is made to travel round by producing a rotating magnetic field in the furnace. In one form shown arcs are produced from concentric hollow carbons to a solid electrode resting on an iron plate. A surrounding iron ring, wound continuously, is supplied by four connections with two alternating currents in quadrature, to produce the rotating field. The ring is protected by an asbestos, mica, firebrick, or other lining, or by an upstanding edge on the lower electrode. The materials are supplied through the hollow carbons which may be raised or lowered by supports on a screw. A single hollow carbon may be used similarly, or a solid upper carbon may enter a hollow in the lower one. In an incandescence furnace, in which the current passes at first through a thin carbon rod, and afterwards through a fused mass of the product, the rotating magnetic field directs the current to one side of the fused mass, and causes it to revolve round the axis of the mass. 7 claims.

17,089. "Rheostats." O. H. Pieper and A. F. Pieper. Dated July 20th, 1897. A divided resistance is made by enclosing a copper or other support between two wider insulating strips, and placing on these alternating conducting plates and insulating washers with thicker end plates secured by pins. The conducting plates may be placed between mica plates. A continuous insulated wire is wound into the spaces thus formed, crossing from each space to the next over the intervening plate; the crossing parts are then bared and soldered to the plates. Such a resistance may be mounted in a circular case. The resistance is formed into a ring, the end plates connected together by screws the remaining spaces filled up with insulating material, and the inside surface smoothed. The ring is secured by clips on arms of a metal frame. A contact spring is carried by an arm of a hollow shaft carrying a knob by which the arm and spring may be turned in contact with the inside of the ring. A pointer on the shaft indicates its position on a dial. The shaft carries also a sliding disc which may be clamped against another disc by tightening a nut on a bolt. The disc is attached to a wheel in gear with a worm on a shaft which may then be turned by hand to turn the contact arm slowly. The apparatus is applicable for use in cataphoric dental operations. The generator terminals are then connected with the ends of the resistance wire; the instrument terminals are connected with one end of the resistance and the contact arm. 10 claims.

17,113. "Improvements in underground systems of electrical distribution for electric railways and the like." W. L. Wise. (A. S. Krotz, W. P. Allen, and O. S. Kelly, United States.) Dated July 20th, 1897. Relates to electric railways and tramways on the conduit system. Conduits, conductors, insulation.—The upper parts of the yokes are reinforced by pairs of webs or ribs between which the insulators are supported by rods. These insulators carry the contact rails and a line of pipes in which the main conductor is laid. The pipes may be lined with insulating material and have water excluding hoods where they open into the manholes. At these points the pipes are interrupted and the conductor is carried round the sides. Feeders which connect the conductor to the contact rail may be made as fuses and can be connected by means of a screw stud with an insulating handle. The contact rail is of angle section, either right or obtuse angle, and is bolted to the insulators with play for expansion and a flexible connection to adjacent lengths. Other modifications are described. 15 claims.

17,142. "Improved electro-mechanical apparatus for the control of electric motors." J. Dulait. Dated July 20th, 1897. Relates to apparatus for starting, stopping, and reversing electric motors, particularly applicable to the control of electric lifts. Consists of three-push contacts for effecting the ascent, stoppage, and descent of the lift, a battery, and a resistance switch in the armature circuit. On making contact at one of the push contacts an electro-magnet attracts a lever carrying plungers which enter mercury cups on the armature leads and forming part of the reversing switch; at the same time contacts are brought together by the lever, and the electro-magnet becoming excited, attracts a lever which closes at the field excitation circuit. Solenoids in the field circuit then actuate the lever of the resistance switch, and the armature is supplied with current, the resistance being gradually cut out. In order to stop the motor, contact is made. On doing this an electro-magnet is excited, a lever released, and the excitation circuit broken and made in such a manner as to prevent sparking. The solenoids are now inactive, and the switch lever is retracted by a spring, thus throwing the armature out of circuit. On the switch-lever making contact the current passes through the releasing magnets of the reversing switch, and, finally, on making contact the magnet actuates the lever and short-circuits the motor. For bringing about the descent of the lift, contact is made on which the magnet is excited and actuates the lever of the reversing switch, so as to supply current to the armature in the opposite direction. 2 claims.

17,158. "Improvements in electric batteries." W. Rowbotham. Dated July 20th, 1897. Relates to batteries of the kind described in specification No. 2,378, A.D. 1897, in which the cells are arranged in a series through which the liquids circulate, and consists in utilising the nitrous vapours or other gases given off in the battery to effect the circulation of the depolariser, and at the same time to effect a saving of the depolariser. In the case where the depolarizer consists largely of nitric acid, it is contained in the smaller compartment of a tank connected by a valve with a larger compartment containing dilute sulphuric acid, in which is a jointed pipe connected to a float and to a pipe, by which the nitrous vapours from the battery are caused to bubble through the sulphuric acid, into which air may also be admitted to decompose the vapours. The battery is supplied from the compartment, and as the pressure in the compartment increases, it ultimately opens the valve and a portion of the liquid from the latter compartment flows into the former. 1 claim.

17,266. "Improvements relating to the starting switches of electro-motors." F. G. Robinson. Dated July 22nd, 1897. A starting switch for electric motors is provided with means for ensuring a slow "on" movement and a rapid "off" movement, which in the latter case may be actuated either automatically or by hand. The switch arm moving over contacts in connection with resistances is mounted on a spur-wheel actuated through slow-speed gearing by a hand-wheel or knob. As the arm moves from the "off" to the "on" position, a volute spring on the axis of the spur-wheel is wound up, the wheel being prevented from returning by a pawl held in engagement with a ratchet by an electro-magnet in the field circuit of the motor. On the failure of the current, or by pressing a knob acting on an extension of the pawl, the pawl is retracted by a spring, and the switch arm is rapidly returned to the "off" position by the spring; or the pawl may be disengaged from a distance by an electro-magnet in parallel with, and acting against, the magnet. The switch arm has a forked end which passes between the contacts and a continuous metal plate separated by insulating material and forming terminals in the path of the current supply. When an additional electro-magnet is employed, there is a second continuous metallic plate behind or below the plate for connecting this magnet in shunt with the magnet. 3 claims.

17,314. "Improvements in and relating to motor vehicles for electric railways." H. H. Lake. (W. A. McGuire, United States.) Dated July 22nd, 1897. Relates to bogies and axle-trucks and brakes for electric motor vehicles. The bogie or truck carries a motor which is supported by sleeves on the driving-axle and a trunnion in a cross-bar forming a part of the equalising frame. Bars support the motor in the event of the driving-axle breaking, and enables the car to be removed for repairs without risk of further damage. The equalising frame consists of two pairs of side plates connected by end bars and resting on springs. In a modification springs are placed at the side of instead of on the top of the axle boxes. The car-supporting frame consists of beams tied by a cross-girder, and having horns to embrace the axle boxes. It rests on springs on the equalising frame and is capable of lateral movement between ribs and on the axle boxes under the control of springs. These springs are secured to caps capable of rocking movement on bases bolted to the side plates and bars respectively. The cap preferably telescopes into the other. The current is supplied by a third rail, and is collected by a shoe carried by a wooden bar secured to the axle boxes by bolts passing through slots in the bar. The brake blocks are hung on bars and are actuated by levers connected by rods. The two levers are pivoted to brackets bolted to the cross bar. The other pair are connected by links to a curved bar which is actuated by the brake rod carrying a roller. 30 claims.

17,315. "An improved process for electrolytically purifying and filtering saccharine liquids or solutions." C. A. Meygret. Dated July 22nd, 1897. Saccharine solutions are electrolysed for the purposes of purification by the means of an electric current; the solutions are caused to circulate between electrodes. A tank is divided into compartments by vertical partitions formed of canvas steeped in fish glue, then dried, and afterwards dipped in a solution of tannin in chromic acid. The compartments are filled with water, and the intermediate compartments are filled with the sugar solution. The electrodes in the compartments are preferably of iron, and those in the compartments are of carbon. A series of tubes connects the water compartments, and a second series connects the sugar compartments. 2 claims.

17,316. "Improvements in electric accumulators." L. G. Garcia. Dated July 22nd, 1897. The electrodes consist of a number of lead bars separated from each other by cross-shaped strips of ebonite; the bars of the same polarity are connected together by strips diagonally arranged as shown. The bars are in the shape of a rectangular prism, and are pierced with a large number of fine intercommunicating holes or passages. The mould consists of a casing held together by clamps and closed at its end by end pieces in which are respectively an opening for the admission of the molten metal and an exit for air. The pieces which almost close one end of the mould serve to form the upper pyramidal end of the bar and the conducting tang. Wires cross the mould in opposite directions to form the holes in the bar. 1 claim.

17,410. "Method of and means for producing the synchronous rotation of two axes situated a considerable distance apart." C. D. Abel. (La Societe Anonyme pour la Transmission de la Force par l'Electricite, France.) Dated July 23rd, 1897. Axes situated at a distance apart, such as those employed in telegraphy or multiplex telephony, are synchronised by employing a specially arranged motor, the armature of which is shunted by the armature circuit of an alternating current generator and a resistance. There is a series of three alternators the armatures of which are all arranged on the axis; the armatures of the earlier alternators feed the magnets of the following one of the series. A flywheel may be mounted on the axis. A special form of driving motor is described, in which the field magnet ring is doubly wound, two fields being provided at right angles, the armature is in series with one of the field windings. The armature is wound in two series of alternating sections, the even-number sections being connected to the even-number commutator bars, and the uneven-number sections to the uneven-number commutator bars. 1 claim.

17,470. "Automatic transformer-switch apparatus." A. Schlatter. Dated July 21st, 1897. In alternating-current transformer systems means are provided for cutting out the transformers when there is no load. An arrangement is shown which consists of a primary network, the secondary and the transformer of group of transformers. There is an auxiliary transformer for controlling the electro-magnetic switches. Differentially wound magnets and their armatures connected to levers carrying contacts are shown. A hook is carried by the lever, and engaging with a catch controlled by the electro-magnet. When a translator is put in the circuit a current flows from the transformer through the magnet coils, the armature is attracted, and the lever moved to complete the circuit so putting in the transformer and breaking the circuit of another transformer. When the circuit is again broken the magnet is no longer excited, and the lever falls again to its original position. This arrangement, with one magnet may be used with small consumption of current, but in larger installations additional magnets are required. These magnets successively come into action as the current increases, the first magnet being cut out but the lever being held down by the catch, &c. Where there are several transformers, each to be controlled separately, additional switches are employed. The lever is fitted with a tube containing a liquid, such as mercury, which prevents oscillation with slight changes of current. 5 claims.

17,471. "Improvements in electrical furnaces." C. D. Abel. (Siemens and Halske, Germany.) Dated July 24th, 1897. The acting surface of the electrodes are made conical or of wedge shape, in order that the materials may fall through the arc. Caking is prevented by flanges on the upper electrode, the regulating movements of which stir up the materials. In one form the flanges are on the iron supports of carbons at some distance from the main electrode, spaces for the escape of gases being thus provided. Otherwise the powdered materials may be moulded with pitch or other substance into blocks, between which the gases evolved can escape. The fused product may be discharged through a hole in the lower electrode, a block at some distance below retaining the unacted-on materials. Or some of the product may be allowed to solidify on the lower electrode so that it forms a receptacle for the fused product, which may be tapped by boring from one side or below, the lower electrode being arranged to permit this. The lower electrode may consist of sloping plates, outside of which are combustion chambers for preliminary heating of the furnace. 7 claims.

17,523. "An improvement in or relating to coin-freed electrical meters." F. J. Beaumont. Dated July 26th, 1897. The current flows through a sector which is gradually turned by the meter until it leaves the terminal and makes contact with the terminal, so directing the current through a resistance which diminishes the light as a warning that the current is about to be cut off altogether. 3 claims.

25,076. "Improvements in and connected with the electrical propulsion of barges and boats on canals and rivers." H. W. Hancock and A. H. Dykes. Dated October 29th, 1897. Screw propellers, rudders, driving gear, electric propulsion, supplying currents for: detachable propelling barge. Relates to means for propelling boats and barges on canals and rivers after the manner described in specification No. 22,276, A.D. 1897. A frame carrying an electric motor is secured to a buoyant rudder, consisting of a hollow blade carried in a frame, and pivoted so that the variable draught of the vessel has no effect upon it. Propeller shafts journalled in the frame, carry screw propellers driven from the motor by sprocket wheel gearing. The current is supplied from the main wires by a trolley and connection. A switch on the tiller regulates the speed of the motor. In a modified arrangement, the propelling device may be carried on a detachable propelling barge, and a cover may be placed over the screw propellers to render the depth of immersion more uniform. Paddles or hydraulic propellers may be used instead of screw propellers. 4 claims.

25,205. "Improvements in coin-freed electric shock machines." G. Poore. Dated October 30th, 1897. Coin action, electricity, administering; fraud preventing. The coin dropped down a shoot enters a loop which extends from an arm over a pair of curved shelves. The arm is provided with a handle for turning it, but is normally prevented from more than a certain amount of play by means of a detent. Owing to the play the coin disengages the detent, and the handle can be turned till a contact arm turning with it reaches a stationary contact. The coin falls out of the loop when clear of the shelves, but the operator receives the current so long as he holds the aforementioned handle and a similar one by turning which the core of the induction coil is shifted to modify the shocks. Coins of insufficient size fall between the shelves. 1 claim.

25,245. "An improved method for varying the speed of electric motors or the electromotive force of dynamo electric machines." H. H. Lake. (E.Cantano, Italy.) Dated October 30th, 1897. Relates to a method of varying the speed of electric motors or the electromotive force of dynamo electric machines by varying the air space between the armature and the field magnets. The pole pieces are connected by a sliding dovetail joint to the magnets. The pole pieces are moved towards or from the armature by right, and left-handed screws on a shaft operated by a wheel. The specification also describes a small motor in which the induced armature may be moved towards or from the inductor coil by means of a movable screw head attached to the armature shaft by ball bearings. 2 claims.